

HEWLETT **hp** PACKARD

## NETWORK ANALYZER 500 kHz to 1.3 GHz

models  
8505A  
8507B  
8501A  
8502A/B  
8503A/B  
11850A/B

TECHNICAL DATA 1 JAN 79

# High Performance RF Network Analyzer

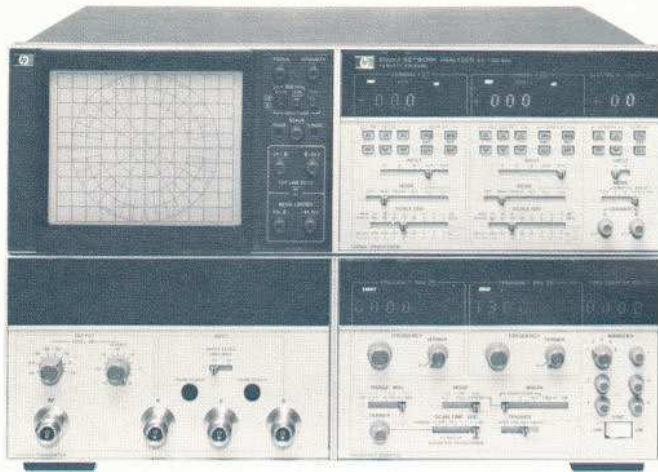


### MEASURE:

**PHASE  
GROUP DELAY  
GAIN  
ATTENUATION  
IMPEDANCE • RETURN LOSS  
S-PARAMETERS  
REFLECTION COEFFICIENT  
DEVIATION FROM LINEAR PHASE  
TRANSFER FUNCTIONS**



# The 8505A Family



**8505A RF Network Analyzer**  
500 kHz to 1.3 GHz

## 8501A Storage Normalizer

- Normalization
- Signal Averaging
- Digital Storage



## Phase-Lock (Option 005)

Phase Lock the 8505A receiver to a stable external source for 1 Hz frequency stability and resolution.

## Test Sets 50 $\Omega$ and 75 $\Omega$



**8502 Transmission/  
Reflection**



**11850  
Power Splitter**



**8503 S-Parameter**

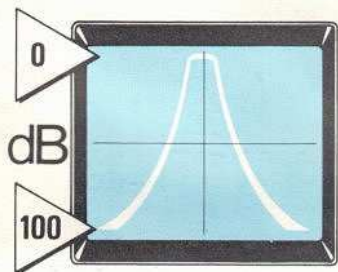
## 8507B Automatic System

- Data in the Form You Need
- Cost Effective Solutions
- Accuracy Enhancement
- Simple Operation



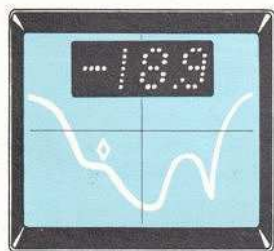


# Features that Define the State-of-the-Art for Network Measurements



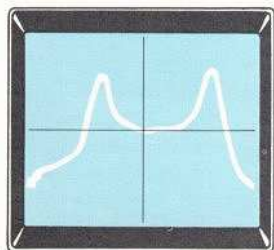
## 100 dB of Dynamic Range to 1.3 GHz

The 8505A has 100 dB of displayed dynamic range over three and one-half decades of frequency. Such performance provides complete definition of filter and amplifier skirts as well as quick identification of spurious responses missed by less sensitive detection schemes or narrower sweeps. Since the 8505A has three receiver inputs, all with full dynamic range, **simultaneous measurements** of any two parameters are possible in one simple set-up. Absolute and ratio measurements of magnitude and phase are possible over the full -10 dBm to -110 dBm range.



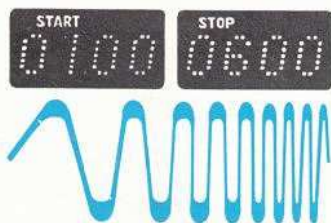
## Digital Readout of Data with Analog Display

Network analyzer measurements are now faster, more accurate, and accomplished with greater resolution than ever before because of the 8505A's ability to digitally present data at any point on the swept CRT trace. Imagine placing the frequency marker anywhere on the CRT trace and immediately reading the frequency, magnitude, phase, and delay digitally with resolutions up to 100 Hz, 0.01 dB, 0.1° and 0.1 nsec respectively. This effectively eliminates the time-consuming and error-prone task of interpolating between graticule lines. Frequency is counted without interrupting the sweep by a built-in, **1300 MHz direct counter**. Data can be read out at any of **five continuously variable markers**.



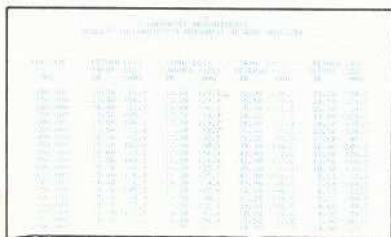
## Direct Group Delay

Group delay of both broadband and narrowband devices is measured directly by the 8505A with the same straightforward ease and simplicity as magnitude and phase. The unique linear FM measurement technique provides the optimum conditions for resolving variations in delay with **1 nsec/division** resolution and up to 80  $\mu$ sec range. Or you may prefer to observe phase distortions directly in the form of deviation from linear phase using the 8505A's revolutionary new **electronic line stretcher**. Simply add or subtract electrical length (up to 1500 m) until the phase characteristic of the test device has been linearized and resolution can be expanded to 1°/division.



## High Performance Sweep Oscillator

The 8505A is a fully integrated stimulus response system containing both the sweep oscillator and tracking receiver. The source provides exceptional operational versatility and technical performance from 500 kHz to 1.3 GHz. For example, it has seven independent sweep modes, including two independent start-stop sweeps that can be alternately swept. Continuous digital readout of the frequency limits provides the convenience you need in choosing and storing test frequency ranges. Low spurious, harmonics, and outstanding residual FM contribute unprecedented precision to swept measurements.

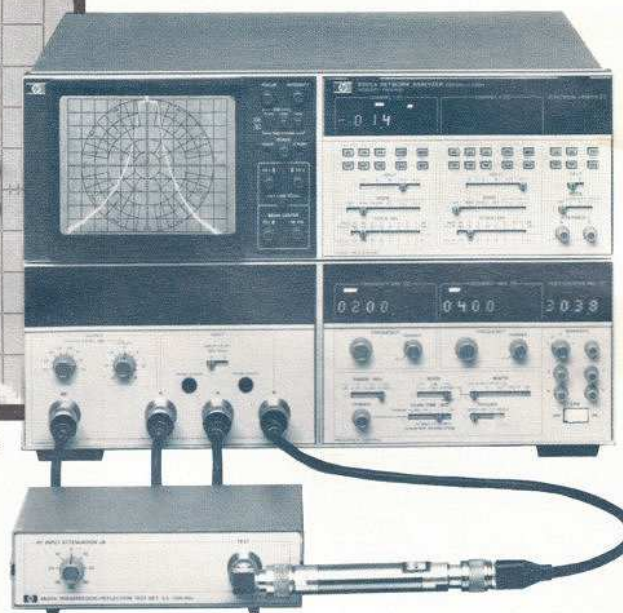
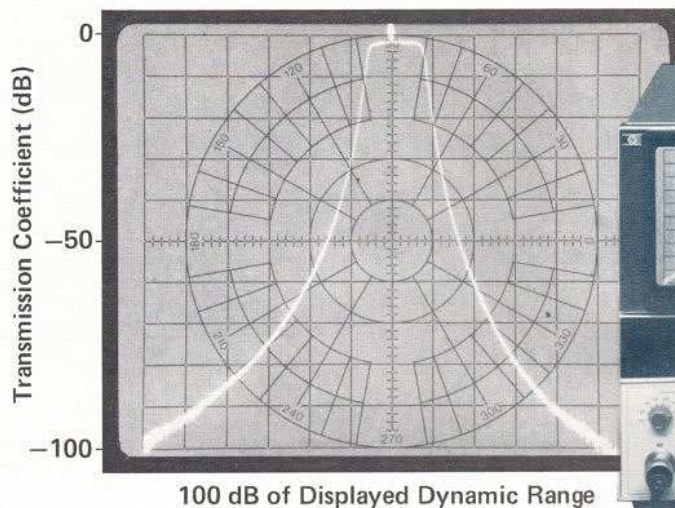


## Fully Automatic Network Analysis

In addition to its remarkable RF performance, the 8505A is the most programmable network analyzer available today. Simple and complete programmability via the **Hewlett-Packard Interface Bus** is available, and the new **Learn Mode** operation virtually eliminates the need for any programming. With Learn Mode any combination of the 8505A's manually-set controls can be stored (Learned) in over 40 locations and later recalled. The 8507B is a fully integrated automatic network analyzer that provides convenience, computation and formatting of data, and accuracy enhancement. See page 11 for more details on the 8507B.

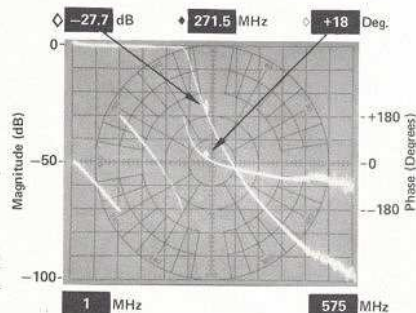


# Precision Measurements of...



## TRANSMISSION

Gain, loss, and phase shift of networks are all measured by the 8505A and displayed directly on a CRT with precision digital readout. 100 dB of displayed dynamic range plus 500 kHz to 1.3 GHz frequency range allow complete identification of passband and skirt responses (see photo above) with one simple set-up.

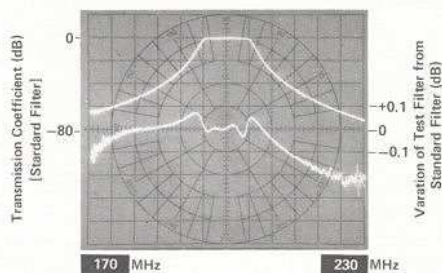


### Magnitude and Phase

It is easy to measure insertion loss and phase shift with the 8505A because you can see the whole filter response on the CRT while selectively reading data at the marker. At the marker position ( $\diamond$ ), the LED displays above the photo indicate -27.7 dB of loss and 18° of phase shift at 271.5 MHz ( $\blacklozenge$ ).

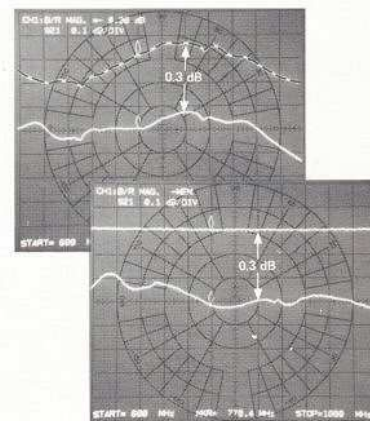
### Comparisons Over Wide Dynamic Range

Full dynamic range in all receiver inputs permits direct ratio comparisons. The standard filter is placed in the reference channel with the test filter in either the A or B channels allowing a ratio display of their deviation. The standard is also displayed at 20 dB/div.



### Normalization

Using the normalization feature of the 8501A Storage Normalizer, the frequency response caused by cables and adapters can be quickly removed for high resolution displays of transmission measurements. For return loss measurements the open-short frequency response can also be removed.



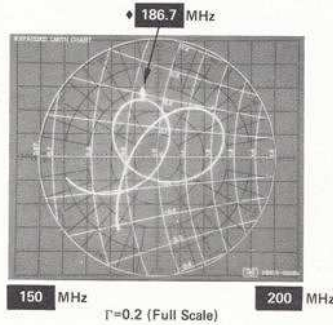
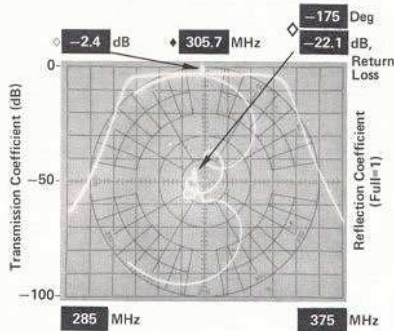


# IMPEDANCE

Direct measurement of impedance in the form of complex reflection coefficient or return loss by the 8505A complements transfer function measurements in the characterization of linear networks. Measurement accuracies are also enhanced by a complete line of test sets with > 40 dB of directivity over the 500 kHz to 1.3 GHz frequency range.

## Reflection and Transmission Coefficients

Simultaneous measurement and display of transmission and reflection coefficients allow real time observation of the tradeoffs between input match and loss or gain. Frequency information to counter accuracy is provided on both traces by the markers.

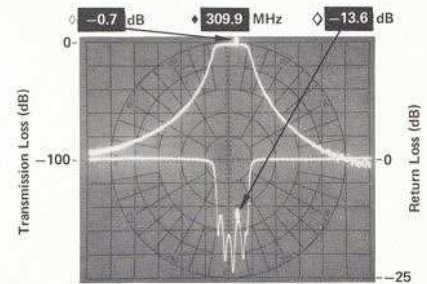


## Direct Impedance

Simply add a Smith Chart overlay to an 8505A reflection coefficient display and complex impedance may be read out directly in ohms. A complete set of normal, compressed, and expanded (see photo above) Smith Chart CRT overlays is provided with each 8505A.

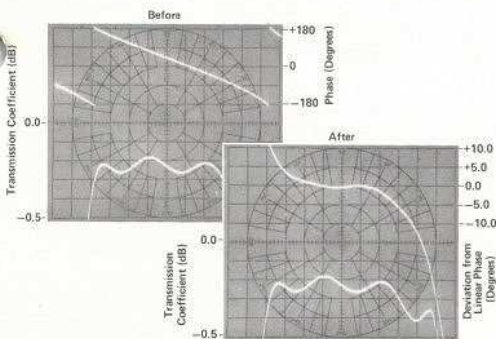
## Return Loss and Transmission Loss

Logarithmic return loss displays provide high resolution measurements of impedances near the system characteristic impedance. Since the 8505A has 20 dB/division resolution, transmission loss with 100 dB range and return loss may be viewed simultaneously without trace interference.



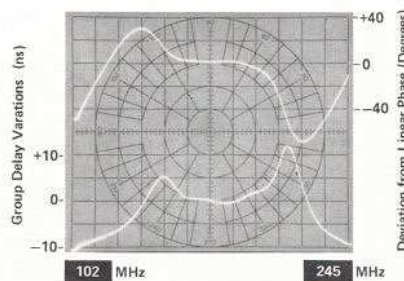
# DISTORTION

The 8505A is ideally suited for network distortion measurements because it directly measures group delay, deviation from linear phase, and high-resolution amplitude deviations. Technological advances such as the 8505A's unique new linear FM group delay measurement technique and revolutionary electronic line stretcher make distortion measurements easier, more accurate, and with higher resolution than previously possible.



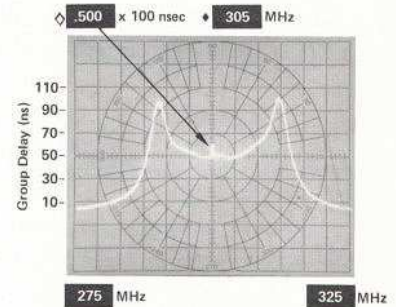
## Deviation from Linear Phase and Amplitude Variation

By simply pushing a button, the 8505A's electronic line stretcher can be used to compensate for a test device's phase shift (up to  $\pm 1700^\circ$  of compensation). Once linearized, the phase non-linearities of a bandpass filter may be viewed at the same high resolution as amplitude variations.



## Deviation from Linear Phase and Group Delay

Since group delay is the slope of the phase characteristic, group delay and deviation from linear phase are equivalent methods of measuring phase distortion. In the photo below, the test device may be adjusted for either constant delay or flat phase response to minimize distortion.

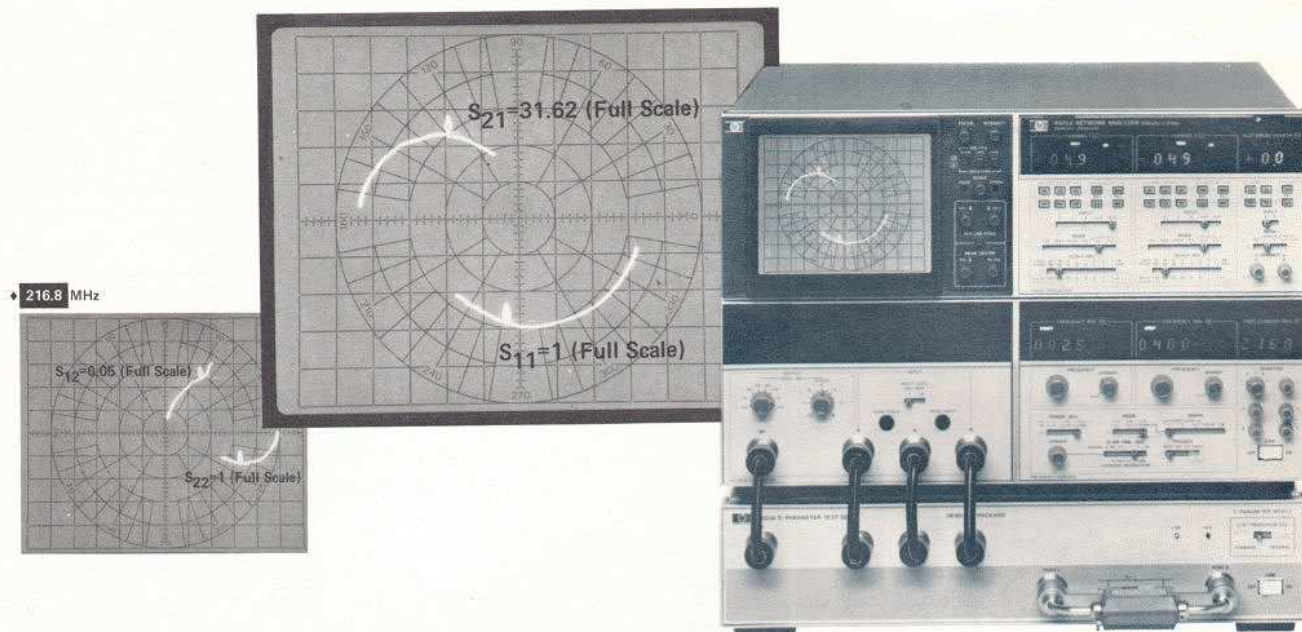


## Group Delay

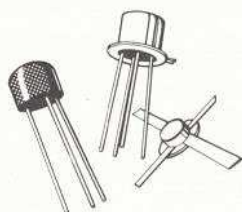
Direct, calibrated measurement of absolute group delay is accomplished with the simple flip of a switch. The 8505A's new linear FM measurement technique displays delay with resolutions up to 1 nsec/division (0.1 nsec digitally). With averaging provided by the 8501A the signal-to-noise ratio can be dramatically improved to enhance the measurement accuracy.



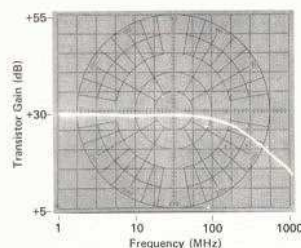
# Characterize such Networks as...



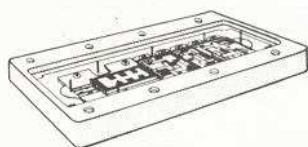
## SEMICONDUCTORS



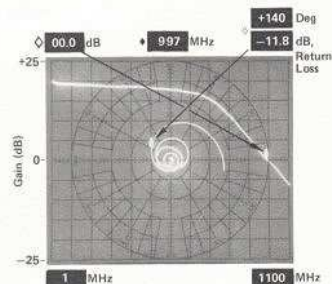
Forward gain,  $S_{21}$ , and input impedance,  $S_{11}$ , are simultaneously measured and displayed using the 8505A and 8503A S-parameter Test Set. With the flip of a switch reverse gain,  $S_{12}$ , and output impedance,  $S_{22}$ , can be similarly determined providing quick and effortless characterization of both bipolar transistors and FET's. Once the S-parameters have been measured they may be directly converted to either h- or y-parameters for analysis or comparison with other low-frequency devices. Besides the network analyzer and S-parameter test set, all that is required for measurement is a dual power supply (bias networks are built in the test set) and an appropriate transistor fixture for either stripline or leaded transistors (HP-11608A, 11600B, or 11602B).



## AMPLIFIERS



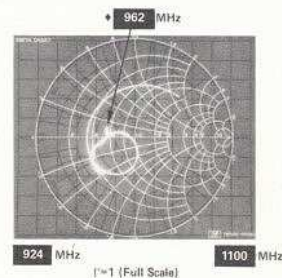
The 8505A's broad frequency range and wide dynamic range make it ideal for testing amplifiers. -110 dBm sensitivity in all three receiver inputs lets you simultaneously measure gain and input impedance of small-signal devices with one straightforward set-up. Calibrated sweeper output power combined with digital readout of absolute power permit careful calibration and adjustment of power sensitive devices. In the CRT photo at right, a 100 kHz to 400 MHz amplifier is tested over three decades of frequency from 1 MHz to 1.1 GHz.



## ANTENNAS



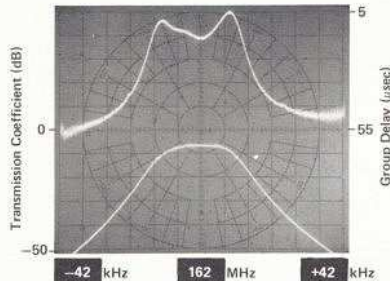
Antenna impedances can be measured and displayed in either rectangular or polar formats. Reflection coefficient of a UHF antenna is shown in the CRT photo at right. A Smith Chart overlay affords direct readout of the real and imaginary portions of impedance in ohms with the frequency directly counted and read out at the marker. The 8505A's electronic line stretcher (reference plane extension) adds further convenience to swept measurements by providing phase compensation for adapters and cables normally required to measure antennas.



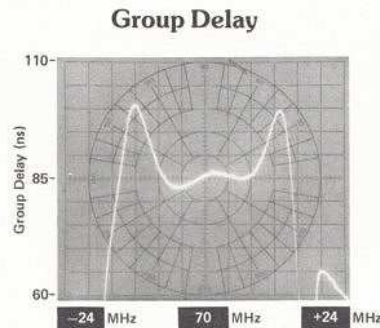
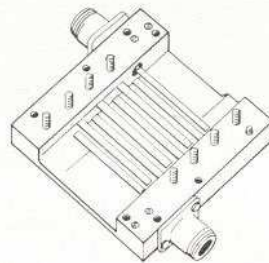


## FILTERS

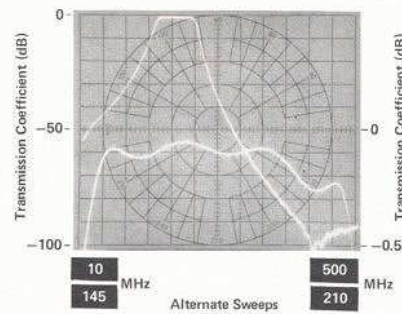
High resolution, wide dynamic range, and three and one-half decade frequency range make the 8505A ideal for filter testing. For example, the ability to alternately sweep two completely independent start/stop frequencies permits simultaneous observation of the passband at high resolution and 100 dB of skirt response. Similarly, insertion loss and return loss can be observed and adjusted simultaneously. Five markers, all settable with counter accuracy, and digital readout of loss, provide a quick, accurate determination of shape factor. Since group delay and phase information are available, passband phase distortions can be measured and adjusted with the aid of a real time display.



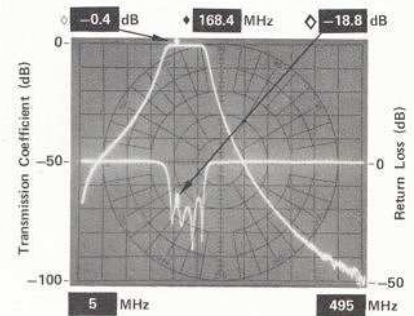
Crystal Filters



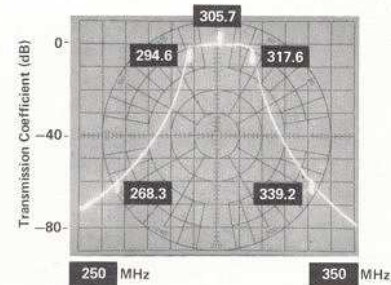
Group Delay



Automatic Alternate Sweeps



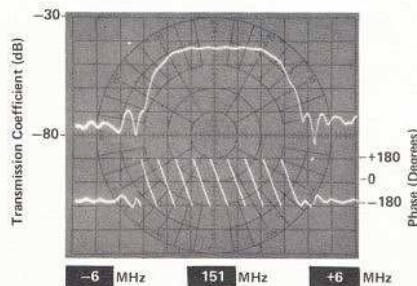
Transmission and Return Loss



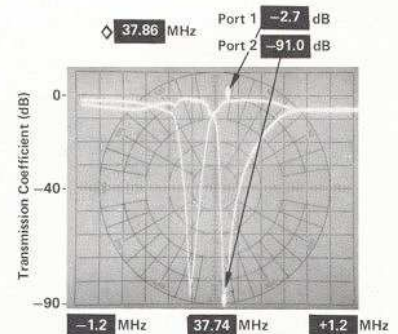
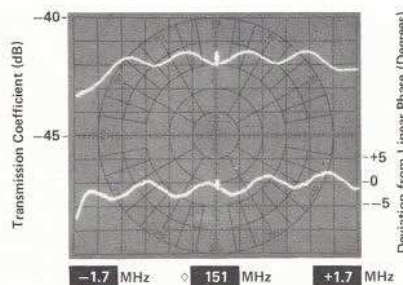
Shape Factor

## AND LOTS MORE...

All types of linear networks, both active and passive, can be characterized using the 8505A. Some other devices typically measured are SAW (Surface Acoustic Wave) devices (see photos below left) or a mobile radio duplexer (see photo at right). Three-port components like duplexers can be rapidly characterized using the 8505A with its three receiver inputs, since the transmission response at both output ports can be observed simultaneously.



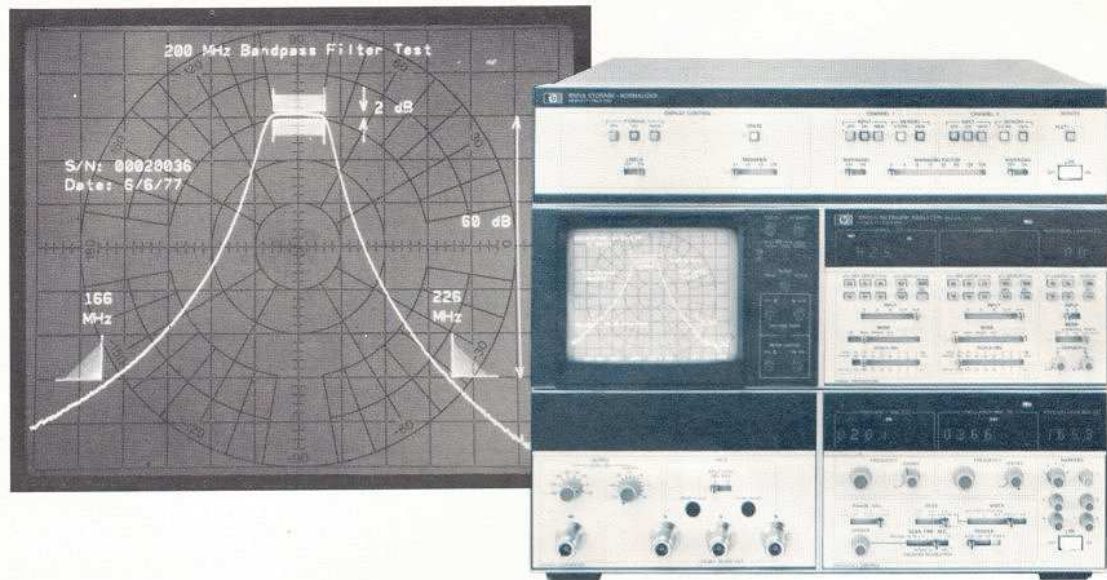
SAW Devices



Communications Duplexer



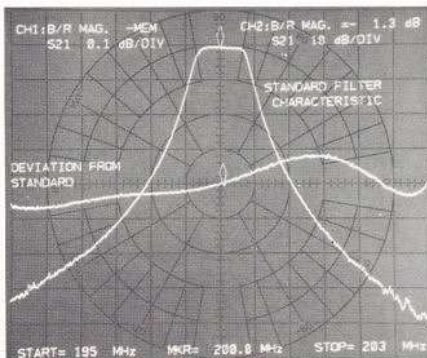
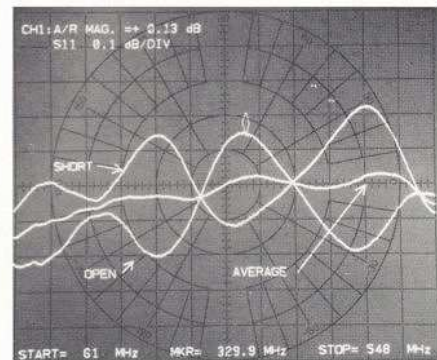
# For More Performance from your Network Analyzer Add the Storage-Normalizer



The 8501A high performance Storage-Normalizer is a dedicated accessory that extends the measurement capability of your HP 8505A RF Network Analyzer. Flicker-free displays with digital storage and CRT annotation of major control settings provide quick, easy documentation. Using normalization, frequency response errors are simply removed. In addition, the 8501A can average signals to dramatically improve signal-to-noise ratios and magnify the display for high accuracy measurements. With a desktop computing controller, computer graphics capability is added to the 8505A CRT, using the standard HP-IB interface, for displaying corrected data, operator messages, or computer programs.

## NORMALIZATION

There is no need to record calibration lines on a CRT or draw X-Y recorder grid lines because the 8501A can automatically store a calibration trace for each channel of the 8505A. In transmission measurements, the frequency response errors at 500 points across the sweep are stored with a push of a button and the difference between calibration and measurement data is displayed directly with frequency response errors eliminated. A 50 percent overrange above and below the screen allows traces to be digitized and normalized even if they are off screen. Using the signal averaging mode of the 8501A, the average of the open and short frequency responses can be stored in memory and then automatically subtracted from reflection measurements, removing both frequency response and reflectometer calibration errors.



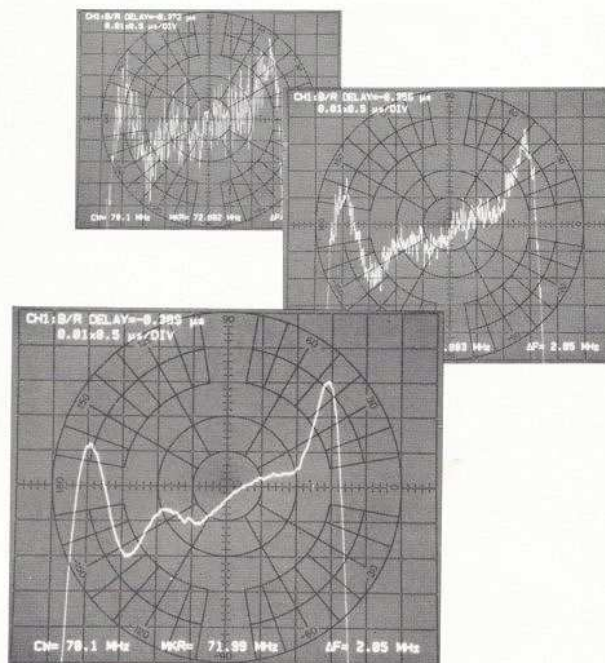
## COMPARISON MEASUREMENTS

For each of the channels of the 8505A, the 8501A can display a previous (stored) input, and either the current input or the difference between the current and stored input. This versatility allows a "standard" characteristic to be stored and viewed as a comparison when adjusting test device performance. Also, the difference can be viewed directly, eliminating complicated visual comparisons of multiple traces.



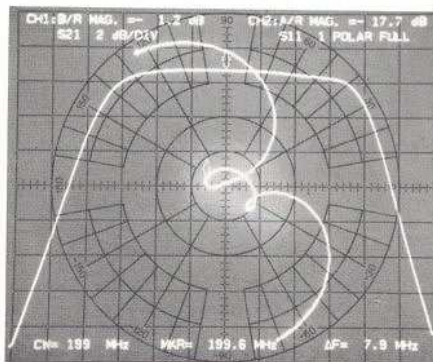
## SIGNAL AVERAGING

This powerful technique adds a new level of accuracy and resolution in network measurements by dramatically improving the signal-to-noise ratio. Both in narrowband group delay measurements and in measurement of low-level signals where noise is a problem, the improvement in resolution is particularly impressive (see photos at right). By digitizing and exponentially averaging repetitive traces, the 8501A functions similar to a video filter, eliminating random noise fluctuations from the display. The averaging factor, or effective video bandwidth, can be selected on the 8501A depending on the signal-to-noise improvement required. The current averaged trace is always displayed and updated with the new average at the sweep rate. As the averaging factor is increased, the current input has less effect on the display, and the time required for the final signal-to-noise improvement increases.



## DIGITAL STORAGE

The 8501A refreshes the 8505A's CRT at a constant rate independent of sweep speed, providing a two-channel, flicker-free display for both polar and rectangular traces. The measurement is digitized and stored in memory with a 500 point resolution in both X and Y directions. Regardless of how slowly you have to sweep, the 8501A draws lines between the digitized points so a crisp continuous CRT display results, permitting easy adjustment of test devices and convenient CRT photography.

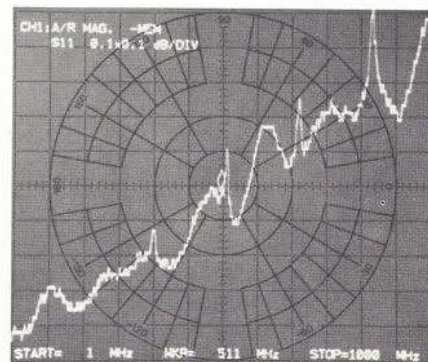


## CRT LABELING

With the 8501A, there is no need to tediously record 8505A settings on the back of CRT photos because all of the major settings are labeled directly on the CRT display. Besides fast and simple documentation, marker readouts of magnitude, phase, group delay, and frequency are written directly on the CRT providing high resolution digital data and the complete analog picture on the same display. Labeling includes major 8505A settings, the digital marker values, counted marker frequency, and test set switching state when the HP 8503 S-parameter Test Set is used.

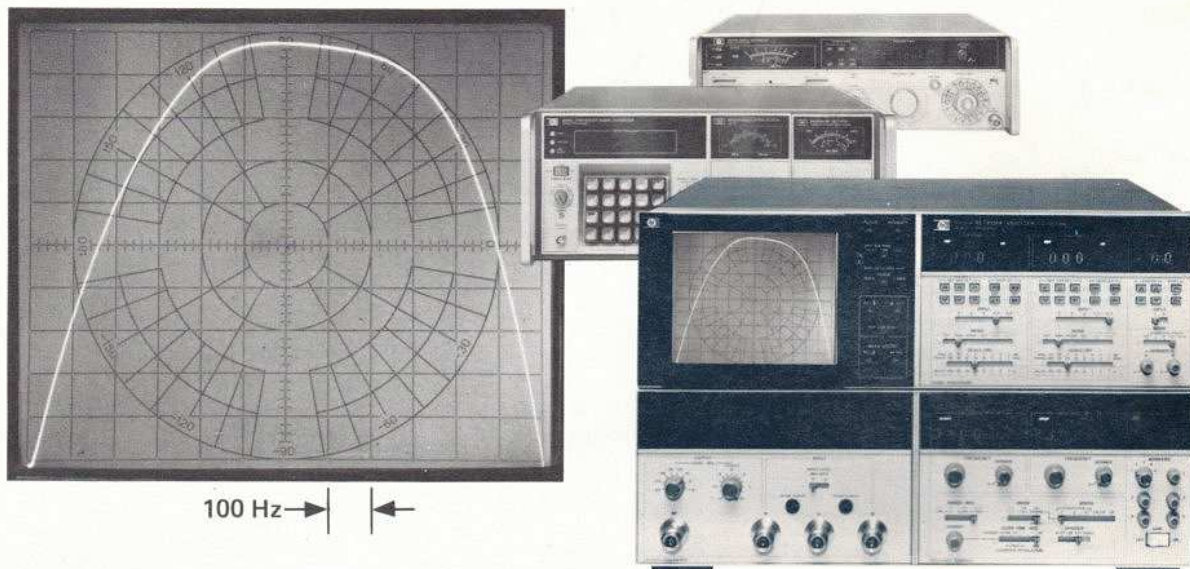
## DISPLAY MAGNIFIER

By magnifying the data stored in the 8501A memory, unprecedented resolutions up to 0.01 dB, 0.1 degrees, and 0.1 nsec per division can be achieved. This represents a tenfold improvement over the resolution of the 8505A alone. Using the magnifier after normalization of frequency response errors greatly speeds and simplifies ultra-high resolution measurements such as broadband amplifier flatness or filter passband magnitude and group delay ripple.





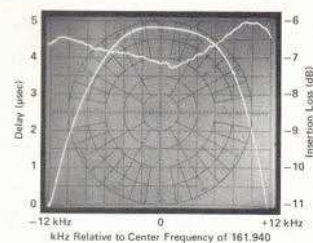
# Add 1 Hz Resolution Capability to Measure...



**8505A Option 005** provides the capability to **phase-lock** the internal receiver of the 8505A to a **stable external source** such as the HP 8660A/C Synthesized Signal Generator or the HP 8640A/B Signal Generator. Addition of an external source combines the outstanding measurement versatility and convenience of the 8505A with the high frequency stability and resolution of the synthesizer or signal generator. With a single switch, the 8505A Option 005 is easily converted from standard broadband operation to narrowband phase-locked operation. Once in phase-lock mode, crisp CRT displays and high resolution digital readouts of transmission magnitude and delay are possible over swept frequency widths ranging from a few hertz to one megahertz. Such capability makes Option 005 ideal for characterizing narrowband devices like crystal filters. Besides transmission magnitude and delay, calibrated displays of return loss, reflection coefficient, phase, and deviation from linear phase are also available over the 8505A's entire 500 kHz to 1.3 GHz frequency range. These powerful measurement features plus one hertz center frequency resolution (with the HP 8660A/C) are conveniently provided by standard (no modifications required) stable sources and the 8505A Option 005.

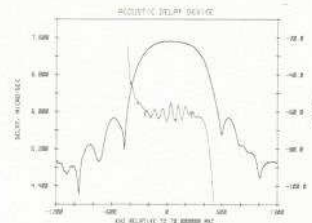
## CRYSTAL FILTERS

The phase-locked 8505A is ideal for characterizing the insertion loss and delay of crystal filters. For example, group delays of up to 80 msec are easily measured, and the display is always directly calibrated independent of sweep time and width because of the 8505A's unique linear FM measurement technique. This greatly simplifies the slow sweep measurements over narrow bandwidths that are often required in crystal characterization. Sweep width is continuously variable through a single control so you can quickly observe the skirts and rejection response with up to 100 dB of displayed dynamic range or narrow-in for a look at passband flatness with 0.01 dB marker resolution. Because phase information is available, crystal resonances and anti-resonances can be determined without the ambiguity of single frequency or magnitude only techniques. Filter measurement and adjustment is simplified and accelerated by the 8505A's dual display channels since any two parameters can be displayed simultaneously.



## SURFACE WAVE DEVICES

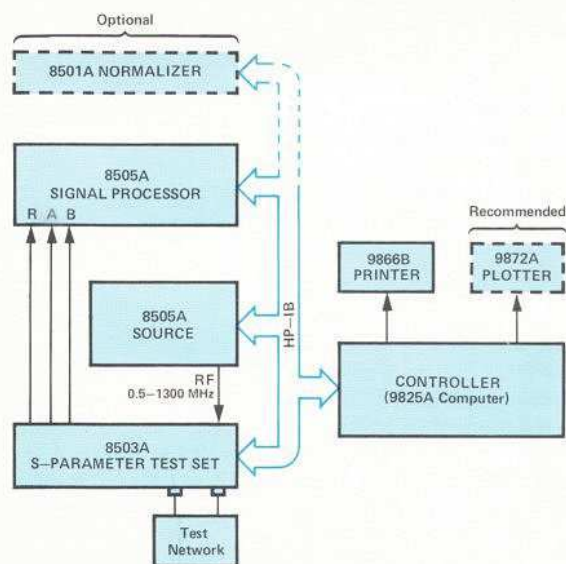
The phase-locked 8505A's 100 dB dynamic range and -110 dBm sensitivity over the 500 kHz to 1.3 GHz frequency range allows you to see a 60 dB filter response even with 40 dB passband insertion loss. Direct digital readouts of sweep width from a few hertz to  $\pm 130$  kHz provide precision for setting up narrowband sweeps, with the flexibility of extending the sweep width to  $\pm 520$  kHz by appropriate rescaling of the readout. Measurements of group delay are possible with up to 80 msec of range depending on the maximum sweep width chosen.



For sweep widths greater than 1 MHz wide, the phase-locked 8505A can be configured with a computing controller to provide the capability of stepping a source, like the 8660A/C, over any section of the 500 kHz to 1.3 GHz frequency range. In this automatic mode of operation the phase-locked 8505A can completely characterize the magnitude, delay, and phase response of devices with long delay and wide passbands. When vector accuracy enhancement is employed, frequency stability and resolution are critical in applications where phase is changing rapidly with frequency, such as measurements of electrically long devices. The synthesizer assures frequency repeatability between calibration and test.



# Even More Powerful Capabilities... the Automatic Network Analyzer



Automatic network measurements can now be accomplished in a straightforward and economical fashion using the 8507B Automatic Network Analyzer. The 8507B combines the high performance RF measurement capability of

the 8505A with the 9825A desktop computer's ability to set up the measurement, read data, and correct the errors caused by RF hardware. It comes with a powerful complement of tailored programs. However, one of the important contributions of the 8507B is the tremendous programming simplicity and flexibility provided by the most programmable network analyzer yet designed, the 8505A, and the Hewlett-Packard Interface Bus (HP-IB).<sup>\*</sup> With the HP-IB, the 8507B system configuration can be easily accomplished or modified to include other instruments using the universal HP-IB cables. In addition, it is possible to automate many measurements with no programming whatsoever using the 8507B's unique **Learn Mode** capability.

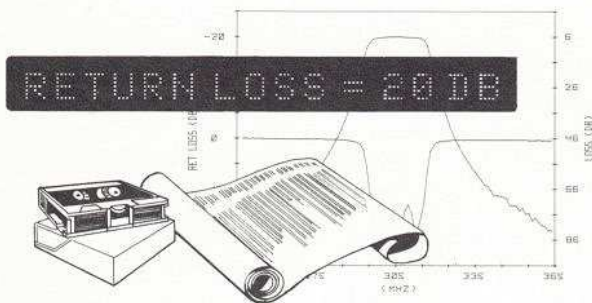
The basic 8507B system includes the 8505A Network Analyzer, the 8503A S-Parameter Test Set, the 9825S Desktop Computer with 9866B Printer, and the 98034A Computer/HP-IB Interface. Also included are the necessary cables, a calibration kit, and a systems table. A set of computer programs for accuracy enhancement and measurement applications come with the 8507B so you can start making measurements immediately. Each 8507B is fully assembled and tested prior to shipment.

<sup>\*</sup> HP-IB is Hewlett-Packard's implementation of IEEE standard 488-1975.



# Major Benefits of Automating

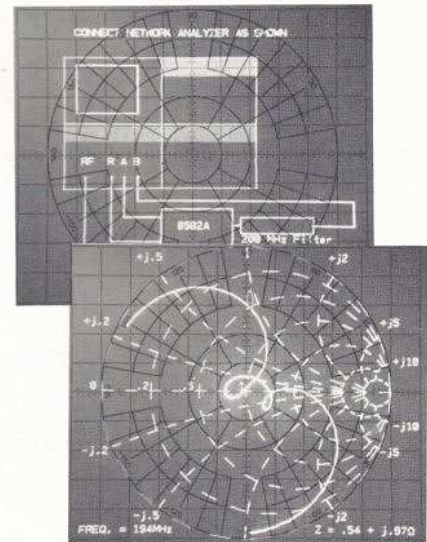
## DATA IN THE FORM YOU NEED



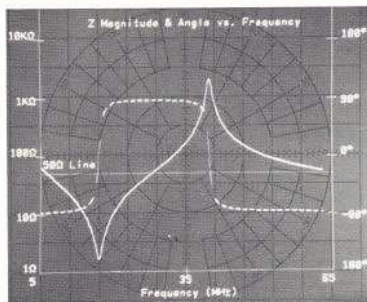
With the powerful algebraic language of the 9825A controller, it is a simple matter to obtain customized printed or plotted outputs. When large quantities of a particular component must be tested, the 8507B will not only perform the test automatically but also perform the labor-saving task of printing or plotting individualized test results for each component. Alternatively, the measurement data may be stored on a cartridge for monitoring quality trends or the effects of manufacturing changes. Data can also be analyzed or statistically summarized directly, bypassing the laborious and error-prone task of manually recording and re-entering data. Data reformatting, such as conversion of return loss to SWR, is also easily accomplished.

## CRT GRAPHICS

Using the graphics capability of the 8501A Storage-Normalizer, a vector can be drawn between any two pairs of X and Y coordinates on the 8505A CRT. Now test limit lines (for passband ripple, insertion loss, shape factors, etc.) can be drawn directly on the screen for device adjustments on the production line or for rapid visual checks of specifications in QA testing. The text mode of operation allows the CRT to be used for annotating measurements (serial numbers, dates, titles, etc.), for program listings or for user instructions during automatic operation. Up to 22 lines of text can be displayed on the CRT. The English and Greek alphabets, numbers, and a complete set of mathematical symbols make up the available character set.



## HIGH-SPEED DIGITIZING



The 8501A is completely programmable via the Hewlett-Packard Interface Bus (HP-IB). This facilitates the rapid transfer of both processed (normalized or averaged) and unprocessed data between the 8501A and a desktop computing controller. A measurement of 500 data points can be digitized and transferred in 650 msec. The data acquisition can be over 10 times faster than the programmable 8505A alone. In production tests, this can greatly reduce test time for "go" and "no go" measurements at multiple frequencies. Data can be quickly and easily reformatted or corrected using standard error correction routines to eliminate frequency response, mismatch, and directivity errors. The corrected or reformatted data can then be displayed directly on the CRT.

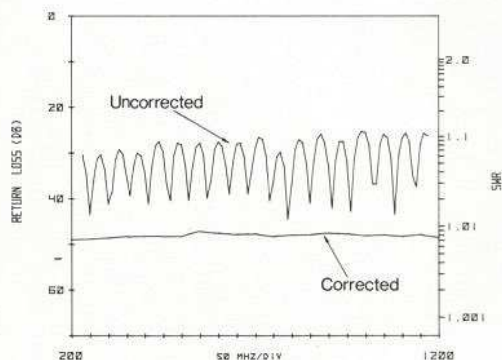


## COST EFFECTIVE SOLUTIONS

In laboratory applications, engineers gain greater circuit insight because of the speed and ease with which data can be accumulated and summarized by the 8505A. The easy-to-use desktop computer programming format reduces programming to a fraction of what it would be for a large computer system. With just a few hours training, engineers with no previous programming experience have written customized programs to solve their specific measurement problems. In production applications, the 8507B dramatically reduces the time and cost of executing complicated test procedures on all types of components. For instance, the system controller can completely set up the RF measurement conditions, print out test instructions, and summarize the final results on a hard-copy printout or an X-Y plot.

[illegible]

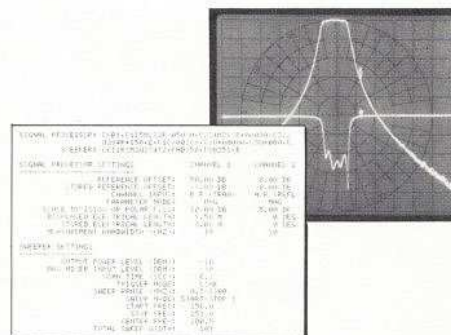
## ACCURACY ENHANCEMENT



Each 8507B system is supplied with a program that permits frequency tracking, mismatch, and directivity errors to be stored at 81 frequencies and then removed from the measurement of the unknown. This provides a degree of accuracy exceeding that possible with the standard 8505A, particularly when adapters or long RF cables are required to connect the unknown to the measurement port. Example applications where accuracy enhancement is especially useful include antenna measurements, RF measurements in environmental chambers, measurements of devices where adapters are required, and measurements of impedances which differ radically from 50  $\Omega$  or 75  $\Omega$ . In the plot at the left, accuracy enhancement provides a 20 dB improvement in the return loss measurement of a load at the end of a six-foot cable.

## SIMPLE OPERATION WITH LEARN MODE

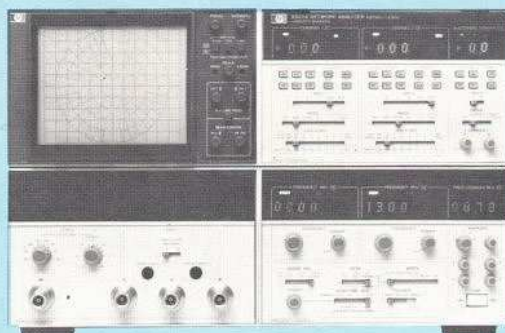
Automatic measurements using the 8507B are now possible with virtually no programming utilizing the unique new Learn Mode of operation. A single key stroke can cause the controller to store (Learn) a data string defining all of the manually-set front-panel control settings of the network analyzer. Once this data string is stored in the controller (or permanently recorded), it can be recalled and will automatically return the network analyzer to its original test conditions. Using Learn Mode, an engineer or technician could program an entire test procedure without writing a single program line! All of the relevant control settings regarding the CRT photo at the right have been summarized and printed using the Learn Mode.





# 8505A Specifications

"SPECIFICATIONS describe the instrument's warranted performance." Specifications apply over the temperature range  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ . "SUPPLEMENTAL CHARACTERISTICS are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters." Supplemental characteristics are denoted as typical.



8505A Network Analyzer

## SOURCE

### FREQUENCY CHARACTERISTICS

**Frequency Range:** 500 kHz to 1.3 GHz in three ranges; 500 kHz to 13 MHz, 500 kHz to 130 MHz, and 500 kHz to 1.3 GHz.

**Swept Frequency Accuracy:**  $\pm 1\%$  of range for linear sweep.

**CW Frequency Accuracy:**  $\pm 2$  counts  $\pm$  time-base accuracy.

**Frequency Resolution\*:**

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
Start/Stop	10 kHz	100 kHz	1 MHz
CW $\pm \Delta F$	10 kHz 1 kHz	100 kHz 10 kHz	1 MHz 100 kHz
CW	100 Hz	1 kHz	10 kHz

**Frequency Stability:** better than  $\pm 0.01\%$  of reading  $\pm 0.01\%$  of frequency range over 10 minutes after warm-up.

### FREQUENCY COUNTER CHARACTERISTICS

Frequency counter measurements are made at any one of five con-

\*Frequency verniers provide continuous frequency adjustment.

tinuously variable marker positions without interrupting the swept RF signal.

**Resolution** (least significant digit):

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
10 ms Sweep Time	10 kHz	100 kHz	1 MHz
100 ms Sweep Time	1 kHz	10 kHz	100 kHz
> 1 second Sweep Time	100 Hz	1 kHz	10 kHz

### Accuracy:

Counter:  $\pm 2$  counts  $\pm$  time-base accuracy.

Marker Frequency:  $\pm 0.002\%$  of scan width  $\pm$  counter accuracy (measured in CW  $\pm \Delta F$ ).

Time Base Accuracy:  $\pm 5$  ppm  $\pm 1$  ppm/ $^{\circ}\text{C}$   $\pm 3$  ppm/90 days.

### OUTPUT CHARACTERISTICS

#### Power:

Range:  $+10$  dBm to  $-72$  dBm.

Accuracy:

Attenuator:  $\pm 1.5$  dB over 70 dB range.

Vernier:  $\pm 1$  dB.

Levelling:  $\pm 0.5$  dB from 500 kHz to 1.3 GHz.

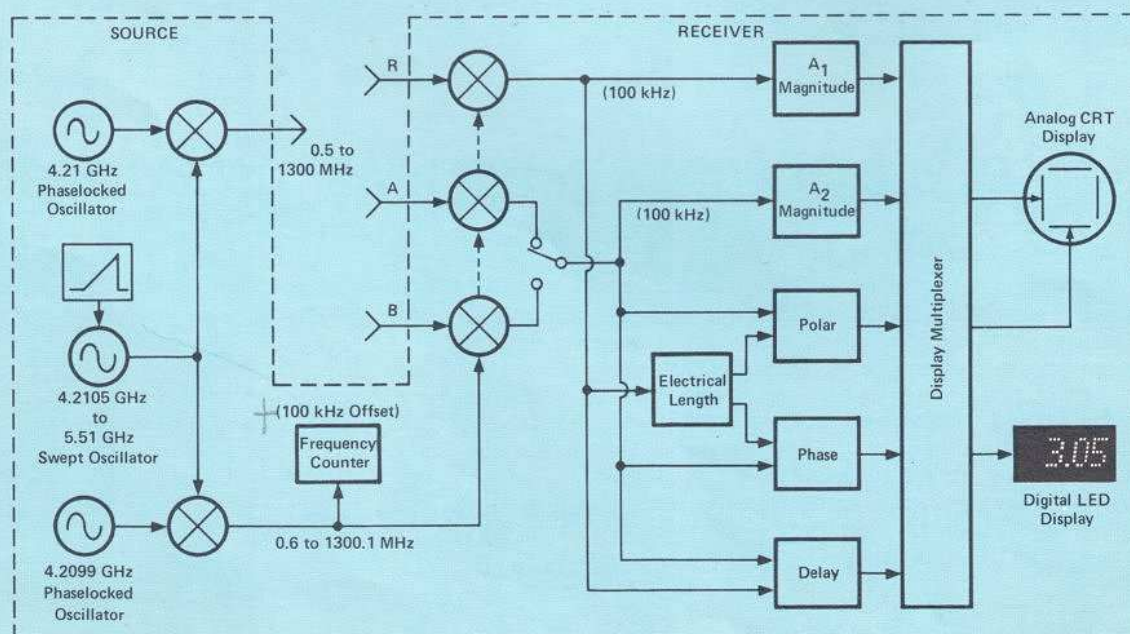
**Impedance:** 50  $\Omega$ ;  $\geq 16$  dB return loss at  $-10$  dBm output level ( $< 1.38$  SWR).

**RF Output Connector:** Type N Female.

#### Spectral Purity:

Residual FM:

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
Residual FM (Hz rms)	20 Hz	200 Hz	2 kHz
Measurement Bandwidth	20 Hz-1 kHz	20 Hz-1 kHz	20 Hz-10 kHz



8505A Schematic



Harmonics: > 25 dB below main signal at +10 dBm output level. Typically > 40 dB below main signal at -12 dB setting of vernier.  
 Sub-harmonics and Spurious Signals: Below -50 dBm at +10 dBm output level.  
 Typical CW Noise (SSB in 1 Hz BW):

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
dB below carrier	70	85	100
Frequency offset from carrier	1 kHz	10 kHz	150 kHz

### GENERAL CHARACTERISTICS

**Sweep Modes:** Linear Full, Log Full, Start/Stop 1, Start/Stop 2, Alternate, CW $\pm\Delta F$ , and CW.

**Sweep Times:** 10 ms to 100 seconds in decade ranges with vernier adjustment or manual sweep using vernier.

**Trigger Modes:** Auto, line sync., single scan or external sync. up to 50 kHz rate with  $\geq 2$  Vpp and  $\geq 1$   $\mu$ s trigger signal.

## RECEIVER

### FREQUENCY RANGE

500 kHz to 1.3 GHz.

### INPUT CHARACTERISTICS

**Input Channels:** Three channels (R, A, and B) with 100 dB dynamic range.

**Damage Level:** +20 dBm or  $\geq 50$  Vdc.

**Maximum Input Level (Selectable):** -10 dBm or -30 dBm input level.

**Noise (10 kHz BW):** -110 dBm from 10 to 1300 MHz; -100 dBm from 2 to 10 MHz; -95 dBm from 0.5 to 2 MHz. Typically, -120 dBm using the -30 dBm input level position and 1 kHz BW.

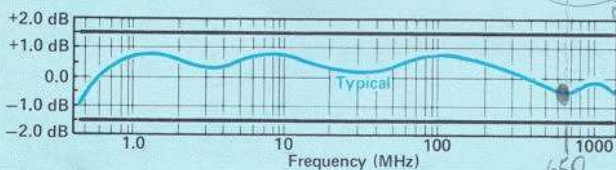
**Impedance:** 50  $\Omega$ ;  $\geq 20$  dB return loss (<1.22 SWR). Typically > 26 dB return loss (<1.11 SWR).

**RF Input Connectors:** Type N Female.

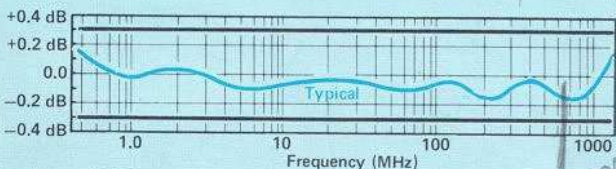
### MAGNITUDE CHARACTERISTICS

#### Frequency Response:

Absolute (A, B, R):  $\pm 1.5$  dB.

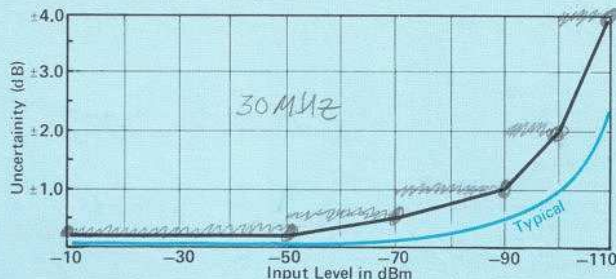


Ratio (A/R, B/R):  $\pm 0.3$  dB from 0.5 MHz to 1.3 GHz.

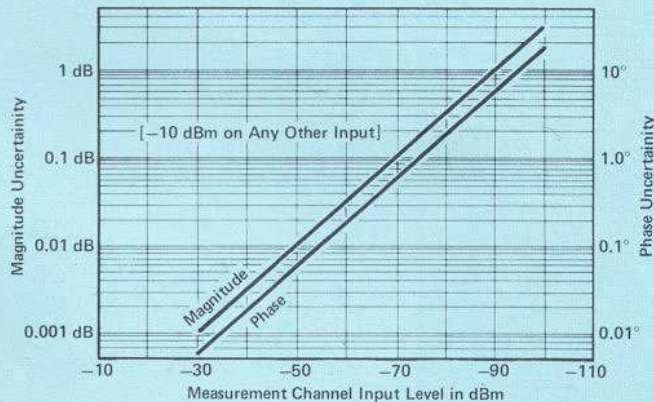


#### Dynamic Accuracy:

- $\pm 0.01$  dB/dB from -20 to -40 dBm.
- $\pm 0.2$  dB from -10 to -50 dBm.
- $\pm 0.5$  dB from -50 to -70 dBm.
- $\pm 1.0$  dB from -70 to -90 dBm.
- $\pm 2.0$  dB from -90 to -100 dBm.
- $\pm 4.0$  dB from -100 to -110 dBm.



**Crosstalk Error Limits:** (> 100 dB isolation between inputs.)



### Reference Offset:

Range:  $\pm 199.9$  dB.

Accuracy:  $\pm 0.03$  dB  $\pm 0.003$  dB/dB of offset.

### Resolution:

Marker Measurement: 0.01 dB over any < 10 dB range; 0.1 dB for  $\geq 10$  dB range.

CRT Display: 0.1 dB to 20 dB/division in 1, 2, 5 sequence.

### Typical Maximum Offset Between 10 kHz and 1 kHz BW Position:

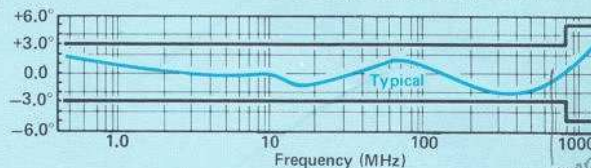
$\pm 0.2$  dB (excluding dynamic accuracy).

### PHASE CHARACTERISTICS

#### Frequency Response:

$\pm 3^\circ$  from 500 kHz to 750 MHz.

$\pm 5^\circ$  from 750 MHz to 1.3 GHz.



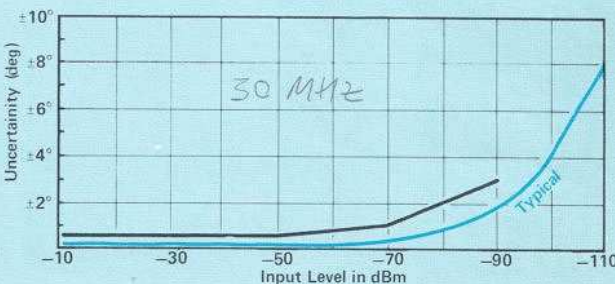
Range:  $\pm 180^\circ$ .

Phase Accuracy:  $\pm 0.01^\circ/\text{degree}$  for  $\pm 170^\circ$ .

& Electrical length  $\pm 0.01^\circ/\text{degree}$   $\pm 0.5^\circ$  for  $\pm 180^\circ$ .

#### Dynamic Accuracy (in 10 kHz Bandwidth):

- $\pm 0.02^\circ/\text{dB}$  from -20 to -40 dBm.
- $\pm 0.5^\circ$  from -10 to -50 dBm.
- $\pm 1^\circ$  from -50 to -70 dBm.
- $\pm 3^\circ$  from -70 to -90 dBm.





# 8505A Specifications Cont'd

**Crosstalk:** See amplitude crosstalk specifications.

**Reference Offset:**

Range:  $\pm 1700$  degrees.

Accuracy:  $\pm 0.3^\circ \pm 0.5\%$  of offset.

**Resolution:**

Marker Measurement:  $0.1^\circ$  over  $<100^\circ$  range and  $1^\circ$  for  $\geq 100^\circ$  range.

CRT Display:  $1^\circ$  to  $180^\circ$  per division in 8 steps.

**Typical Maximum Offset Between 10 kHz and 1 kHz**

**BW Position:**  $\leq \pm 5^\circ$  (excluding dynamic accuracy).

## POLAR CHARACTERISTICS

Frequency Response, Dynamic Response, Reference Offset, and Marker Measurement specifications are the same as magnitude and phase characteristics.

**CRT Display Accuracy:** Actual value is within less than a 3 mm circle of the displayed value.

**Tracking Between dB Offset Controls and Polar Full**

**Switch Positions:**  $\leq 0.2$  dB.

**Full Scale Magnitude Range:** 1 to 0.01 in a 1, 0.5, 0.2 sequence.

**CRT Display Resolution:** Magnitude gratitudes at 20% of full scale spacing; phase gratitudes at  $10^\circ$  increments around unit circle.

## DELAY CHARACTERISTICS

**Frequency Response:**  $\pm 1$  ns from 500 kHz to 1.3 GHz.

**Delay Accuracy:**  $\pm 3\%$  of reading  $\pm 3$  units.

(Units = 1 nsec for 0.5 to 1300 MHz range, 10 nsec for 0.5 to 130 MHz range, and 100 nsec for 0.5 to 13 MHz range.)

## Range, Resolution and Aperture<sup>2</sup>

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
Range	0 to 80 $\mu$ s	0 to 8 $\mu$ s	0 to 800 ns
Resolution			
CRT:	100 ns	10 ns	1 ns
Marker:	100 ns	10 ns	1 ns
Marker over limited range:	10 ns ( $<1 \mu$ s)	1 ns ( $\leq 100$ ns)	0.1 ns ( $\leq 10$ ns)
Aperture <sup>2</sup>	7 kHz	20 kHz	200 kHz

**Reference Offset:**

Range:  $\pm 1999$  units.

Accuracy:  $\pm 0.3$  units  $\pm 0.3\%$  of offset.

## ELECTRICAL LENGTH/REFERENCE PLANE EXTENSION CHARACTERISTICS

**Calibrated Electrical Length:**

Range and Resolution:<sup>3</sup>

Frequency Range (MHz)	0.5 to 13	0.5 to 130	0.5 to 1300
Range			
x1	$\pm 19.9$ m	$\pm 1.99$ m	$\pm 19.9$ cm
x10	$\pm 100$ m	$\pm 10$ m	$\pm 1$ m
Resolution			
x1	10 cm	1 cm	0.1 cm
x10	1 m	10 cm	1 cm

Accuracy:  $\pm 3\%$  of reading  $\pm 1\%$  of range.

<sup>1</sup>  $\pm 3$  Units may be calibrated out with thru connection.

<sup>2</sup> Typical measurement Aperture using linear FM modulation technique.

<sup>3</sup> Vernier provides continuous adjustment of electrical length.

**Electrical Length Linearity:**  $\Delta\phi = 0.7\% \times 1.2f$  (MHz)  $\times 1$  (meters).

**Linear Phase Substitution (degrees/scan):**

Range:  $\pm 1700^\circ$  per scan with  $0^\circ$  offset.

$\pm 1.4$  km

$\pm 4.7 \mu$ sec

scan width (MHz) or scan width (MHz)

Resolution:  $10^\circ$ .

Vernier Range: Continuously variable over  $>10^\circ$  range.

Accuracy:  $\pm 3\%$  of reading  $\pm 10^\circ$ /scan.

Phase Compensation Linearity:  $<\pm 0.2\%$  of phase slope inserted.

## GENERAL CHARACTERISTICS

**CRT Reference Position:** Reference lines for Channel 1, Channel 2, and beam center (in Polar) may be independently set to any position on the CRT Display.

**Display Bandwidth:** Selectable IF bandwidths of 10 kHz and 1 kHz. A video filter position is also provided.

**CRT Background Illumination:** Illumination control provided for CRT photography.

**Phosphor:** P39

**CRT Overlays:** Smith Charts (2, 1, 0.5, 0.2, 0.1 full scale), Log Charts (10 MHz, 100 MHz, and 1000 MHz).

**CRT Camera Adapter:** HP 197A Option 006 camera is a direct fit. Camera bezel adapter model 10375A is required to convert the standard 197A camera to fit the 8505A display.

**Auxiliary Outputs:**

Channel 1 and 2 Outputs: 0.25 V/display division with 2 k $\Omega$  source impedance.

Sweep Output: 0.25 V/display division with 2 k $\Omega$  source impedance.

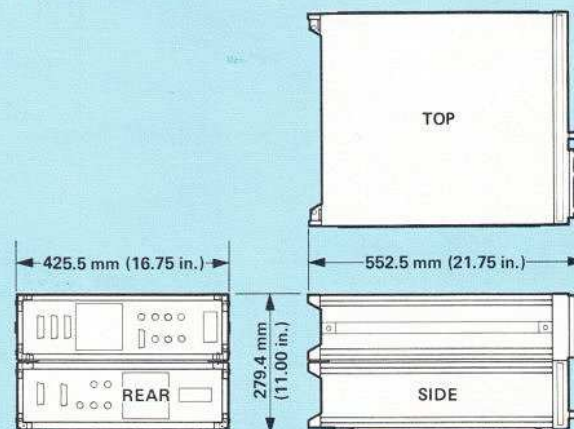
Pen Lift: DC coupled, 200 mA current sink.

**Programming:**

The 8505A provides a remote programming interface using the Hewlett-Packard Interface Bus with Learn Mode. Both the 8505A source and receiver may either receive instructions or send data to a remote controller. Learn Mode allows the system controller to store ("learn") the state of the 8505A's manually-set controls for later recall.

**Power:** Selection of 100, 120, 220, or 240 V  $\pm 5\%$   $-10\%$ . 50 to 60 Hz approximately 275 watts.

**Dimensions:** 279 mm H  $\times$  426 mm W  $\times$  553 mm D (11"  $\times$  16 3/4"  $\times$  21 3/4").



**Weight:** Net, 36 kg (86 lb). Shipping, 48 kg (106 lb).



# Phase-Lock Performance Characteristics

Option 005 of the 8505A provides circuitry to allow the source in the 8505 to be phase-locked to a stable external source such as an HP 8640B or HP 8660C. In the phase-locked mode, narrow-band measurements such as crystal filters are easily made with the increased resolution and stability of the external source.

## SOURCE

### FREQUENCY CHARACTERISTICS

Modes (8505A): CW and CW  $\pm \Delta F$  only.

Range and Resolution (8505A and 8660C/86602B/86632B):  
(Total Frequency Range: 1 to 1300 MHz)<sup>1</sup>.

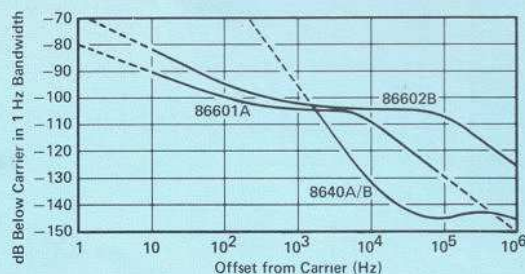
	8505A Frequency Range (MHz)		
	0.5 to 13	0.5 to 130	0.5 to 1300
<b>CW Resolution</b> (Set on 8660C)	1 Hz	1 Hz	1 Hz
<b><math>\pm \Delta F</math> Resolution</b> (Set on 8505A)	1 Hz	10 Hz	100 Hz
<b>Max <math>\pm \Delta F</math></b>	1.3 kHz	13 kHz	130 kHz

Range and Resolution (8505A and 8640B Opt. 002): (Total Frequency Range: 0.5 to 1024 MHz)<sup>1</sup>.

	8640 Frequency Ranges (MHz)	8505A Frequency Range (MHz)		
		0.5 to 13	0.5 to 130	0.5 to 1300
<b>CW Resolution</b> (Set on 8640B)	0.5-1 1-13 16-128 128-1024	0.1 Hz 1 Hz	10 Hz	10 Hz 100 Hz
<b><math>\pm \Delta F</math> Resolution</b> (Set on 8505A)	All Freq. Ranges	1 Hz	10 Hz	100 Hz
<b>Max <math>\pm \Delta F</math></b>	0.5-8 8-16 16-1024	1.3 kHz 1.3 kHz	13 kHz 13 kHz	130 kHz

**Typical System Residual FM:** The Residual FM of a phase-locked 8505A approaches that of the 8660C, 86602B/86632B, or 8640B.

### Source Phase Noise



### OUTPUT CHARACTERISTICS

Power output, harmonics, spurious outputs, RF phase noise, etc., are determined by the 8660C with 86602B and 86632B or the 8640B.

## RECEIVER

Magnitude and phase characteristics are unchanged with the exception of the dynamic range specification. In some instances the phase noise of the source and 8505A may interact to limit the achievable range of notch filter measurements. See Source Phase Noise characteristics.

### DELAY CHARACTERISTICS

**Accuracy:**  $\pm 3\%$  of reading  $\pm 3$  units. One unit is equal to the maximum resolution per major division for the frequency range of measurement.

Range, Resolution and Aperture (8660C/86602B/86632B or 8640B): (8505A indicated units  $\times 1000$ )<sup>1</sup>.

	8505 Frequency Range (MHz)		
	0.5 to 13	0.5 to 130	0.5 to 1300
<b>Range</b>	0-80 ms	0-8 ms	0-800 $\mu$ s
<b>Resolution:</b> CRT & Digital Marker	100 $\mu$ s	10 $\mu$ s	1 $\mu$ s
Digital Marker with Delay	10 $\mu$ s	1 $\mu$ s	100 ns
Switch Setting	<1 ms	<100 $\mu$ s	<10 $\mu$ s
<b>Aperture*</b>	1.5 kHz	2.0 kHz	4.0 kHz

\*Aperture is the minimum frequency change for which a change in group delay can be detected. This specification represents worst case aperture.

### ELECTRICAL LENGTH CHARACTERISTICS

**Accuracy:**  $\pm 3\%$  of reading  $\pm 3\%$  of range.

**Calibrated Electrical Length, Range, and Resolution**  
(8660C/86602B/86632B or 8640): (8505A digital read-outs  $\times 1000$ )<sup>1</sup>.

		8505A Frequency Range (MHz)		
		0.5 to 13	0.5 to 130	0.5 to 1300
<b>Range</b>	$\times 1$ $\times 10$	$\pm 19.9$ km $\pm 100$ km	$\pm 1.99$ km $\pm 10$ km	$\pm 199$ m $\pm 1$ km
<b>Resolution</b>	$\times 1$ $\times 10$	100 m 1 km	10 m 100 m	1 m 10 m

**Linear Phase Substitution (degrees/scan):**  $\pm 1700^\circ$  per scan with  $0^\circ$  offset.

<sup>1</sup> If a  $\pm \Delta F$  (peak deviation) of other than 130 kHz (1300 MHz Range), 13 kHz (130 MHz Range), or 1.3 kHz (13 MHz Range) are chosen the maximum range and resolution of Delay and Electrical Length must be computed. A maximum  $\pm \Delta F$  of 130 kHz is possible on all ranges.

### GENERAL CHARACTERISTICS:

#### RF Inputs:

L.O. Drive Input Level: 10 dBm  $\pm 2$  dB (Rear panel BNC).

RF Drive Input Level: 0 dBm  $\pm 2$  dB (Rear panel BNC).

**Tunable FM Output:**  $\pm 1.3$  V maximum (rear panel) BNC with output level controlled by  $\pm \Delta F$  control on front panel of 8505A.  $\pm 1.3$  V output is obtained independent of the frequency range switch setting.

#### Capture Range of Phase-Lock Loop:

100 kHz (0.5-13 MHz Range).

400 kHz (0.5-130 MHz Range).

4 MHz (0.5-1300 MHz Range).

**Standard/Phase/Lock Operation:** Rear panel switch can disable all phase-lock circuitry when using the instrument in its standard (non phase-lock) operating mode.

#### Ordering Information:

**8505A RF Network Analyzer**

**Option 005:** Phase-Lock

**Option 007:** Labeling Interface

**Option 907:** Front Handle Kit

**Option 908:** Rack Flange Kit

**Option 909:** Rack Flange/Front Handle Kit

**Option 910:** Extra Manual

**08505-60201** Retrofit Kit

A field installable version of the Option 005 for the 8505A with serial prefix numbers 1653 and below.

**08505-60200** Retrofit Kit

A field installable version of the Option 005 for the 8505A with serial prefix numbers 1710 through 1806.

**08505-60226** Retrofit Kit

A field installable version of the Option 005 for the 8505A with serial prefix numbers 1816 and above.



## Phase-Lock Performance Characteristics Cont'd

### 8640 AND 8660

There are two stable sources recommended for phase-lock operation with the 8505A: the HP 8640 Signal Generator and the HP 8660 Synthesized Signal Generator.

The 8640 is a high-Q cavity oscillator generator covering the 500 kHz to 512 MHz range and is available in two models. The 8640B has a built-in frequency counter that permits center frequency measurements with 100 Hz resolution. The lower-cost 8640A indicates its center frequency on a dial scale but higher resolution can be achieved using the 8505's built-in counter. 8640B Option 002 extends the standard frequency range of 512 MHz to 1024 MHz.

The 8660 Synthesized Signal Generator family consists of either a keyboard entry or a thumbwheel switch controlled mainframe together with a series of RF and modulation plug-ins. Both mainframes have programmable capabilities. For general applications the 8660C mainframe, the 86632B FM modulation plug-in, and either the 86601A (10 kHz to 110 MHz) or 86602B (1 MHz to 1.3 GHz) RF plug-ins are recommended.

For both sources the frequency sweep is obtained by connecting a linear voltage ramp modulation from the 8505 to the signal generator's EXTERNAL FM input. The essential difference between the use of the 8640 and 8660 with the 8505 Option 005 are outlined below:

The 8640 is less expensive and, because it is based on a tuned-cavity oscillator, it has better phase noise characteristics than the 8660. However, the 8505A phase-locked to the 8640 is limited to a directly calibrated sweep of  $\pm 1.3$  kHz at center frequencies below 10

MHz and  $\pm 13$  kHz to 16 MHz, while the 8660 can sweep  $\pm 130$  kHz. Above 16 MHz both the 8640 and 8660 can be used with Option 005 for direct calibrated sweeps of  $\pm 130$  kHz. The 8640B center frequency resolution decreases from 10 Hz to 100 Hz above 128 MHz, and its maximum frequency is 1024. The 8660 has a 1 Hz center frequency resolution up to 1300 MHz. The 8640 is not programmable, while the 8660 is fully programmable on the Hewlett-Packard Interface Bus.

### 8660 PLUG-IN CONSIDERATIONS

#### 86601A, 86602B, and 86603A RF Sections

The 86601A (10 kHz to 110 MHz) in its frequency range has approximately 10 dB better phase noise characteristics than the 86602B (1 MHz to 1300 MHz) or the 86603A (1 MHz to 2600 MHz).

#### 86632B, 86633B, and 86635A Modulation Sections

The 86632B (AM and FM) and the 86635A (FM and  $\phi$ M) are equally good choices since they allow peak deviations up to 1 MHz and rates down to dc. This provides flexibility both in choosing sweep width and sweep rates. The FM peak deviation of the modulation section or RF section is usually the limiting factor in determining the maximum sweep width of the 8505A Option 005 while the FM rate controls the sweep rate. If phase-lock operation is required over bandwidths greater than  $\pm 130$  kHz, maximum  $\pm \Delta F$  sweeps of  $\pm 260$ ,  $\pm 390$ , and  $\pm 520$  kHz are possible with the 8505A Option 005 by rescaling the  $\pm \Delta F$  readout by 2, 3, or 4. Because of the phase-locked center frequency on the 86633B, peak deviations are limited to 100 kHz maximum and the rate cannot be lower than 20 Hz. Since this precludes both slow sweep speeds and peak deviations of  $\pm 130$  kHz operation with the 86633B is not recommended.

## 8501A Specifications

*"SPECIFICATIONS describe the instrument's warranted performance." Specifications apply over the temperature range  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ . "SUPPLEMENTAL CHARACTERISTICS are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters." Supplemental characteristics are denoted as typical.*



Front View



Rear View

### 8501A Storage Normalizer

#### DISPLAY

##### RECTANGULAR DISPLAYS

Horizontal Display Resolution: Two display channels, 500 points per channel (0.2% of full scale, 0.24 mm).

Vertical Display Resolution: 500 points displayed full scale (0.2% of full scale) plus a 50% overrange (250 points) both above and below full screen. The overrange capability is useful in storing and normalizing traces that exceed full scale.

##### POLAR DISPLAYS

Display Resolution: Two display channels, 250 points per polar display (0.2% of full scale, 0.2 mm in X and Y).

##### NORMALIZATION

Two traces can be stored in memory (one for each channel) with the same resolution as the displayed trace.

#### DISPLAY MAGNIFIER

When the display magnifier is used the display is magnified by a factor of 1, 2, 5, or 10 giving a display resolution of 500, 250, 100, or 50 points in Y (Rectangular) and in X and Y (Polar).

#### DISPLAY TRACKING

Visual offsets between direct 8505A and stored displays are approximately  $\pm \frac{1}{2}$  CRT minor division ( $\pm 1$  mm).

#### HORIZONTAL INPUT SWEEP TIMES

100 sec max/10 msec min.

#### CONVERSION TIME

10 msec max for  $500 \pm 2$  data points (20  $\mu$ sec per point).



# 8501A Specifications Cont'd

## DISPLAY REFRESH TIME

Nominally 20 msec depending upon information displayed.

## MARKERS

All five markers are also available in the digital display mode. The marker gives the value of the current input before normalization and averaging.

## OFFSETS

The X, Y, and polar display offsets can be adjusted over a  $\pm 10\%$  range of screen by means of potentiometers on the rear panel of the 8501A.

## INPUT/OUTPUT

### HP-IB INTERFACE CAPABILITIES

#### Remote programming:

**Learn Mode:** This feature provides the ability to output the current instrument state to a computing controller.

**Input Data:** Data for graphics or other purposes can be sent to the 8501A at the rate of:

- ASCII mode, 600 points per second.
- Binary mode, 10,000 points per second.

**Output Data:** Data can be read from the 8501A at a rate of:

- ASCII mode, of 800 points per second.
- Binary mode, 9000 points per second.

**Graphics:** Data for graphics can be read into the 8501A and viewed in two types of displays.

**TEXT DISPLAYS:** 22 lines of text with 54 characters per line can be displayed on the CRT. Up to 500 characters can be displayed at one time without a flicker.

**VECTOR DISPLAYS:** Lines can be drawn on the display between any two points with a resolution of 432 points in X and 360 points in Y (nominal).

### LABELING INTERFACE

Labeling information is brought from the 8505A to the 8501A by means of the labeling interface cable on the rear panel. All major control settings of the 8505A and 8503A and phase-lock indication are labeled on the CRT.

### AUXILIARY OUTPUTS XYZ

(BNC female connectors on rear panel).

X- 1 V full screen, 83 mV/div (12 div).

Y- 1 V full screen, 100 mV/div (10 div).

Z- -1 V blanks display, +2 V unblanks display.

(Signal compatible for all HP CRT displays such as 1332, 1304, or 1310.)

## GENERAL

### DISPLAY CONTROLS

**Storage Off:** The 8501A is bypassed so the display returns to normal analog operation.

**Storage On:** Turns on digitally stored display.

**Storage Hold:** The current display is not updated and is frozen for CRT photography or further analysis.

**Erase:** Display and memory are erased.

**Labels:** Switches all display labeling on or off.

**Magnifier:** Expands the display by a factor of 1, 2, 5, or 10.

### PROCESSING FUNCTIONS (CHANNEL 1 AND 2)

**Input Off:** Display of channel 1 (2) is blanked.

**Input On:** Channel 1 (2) measurement is displayed.

**Input-Mem:** The difference between the channel 1 (2) measurement and the stored memory content is displayed (normalization).

**Memory Store:** The current measurement is stored in memory.

**Memory View:** The stored memory content is displayed.

**Averaging:** The data averaging function for channel 1 (2) is switched on or off.

**Averaging Factor:** The degree of averaging is selectable from 2, 4, 8, ... to 256. The current averaged trace is always displayed and updated at the sweep rate according to the expression where the new averaged trace ( $A_n$ ) is the sum of the current input ( $S_n$ ) divided by the averaging factor (F) and the previous averaged trace ( $A_{n-1}$ ) times the averaging factor minus one (F-1) divided by the averaging factor (F).

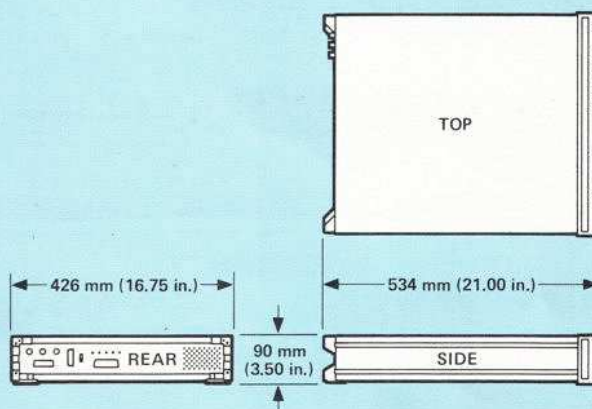
$$A_n = \frac{S_n}{F} + \frac{(F-1)A_{n-1}}{F}$$

**Includes:** HP-IB cable and processor interconnect cable.

**Accessories:** The 11864A Labeling Interface Kit provides the labeling interface boards and connectors for the 8505A; 8505A Option 007 has these boards and connectors installed. The 85010B Basic Measurements Program Pac contains applications programs for use with the 8501A, 8505A, and 9825A Computer. The 85010A BMP Pac is used with the 9830 Computer.

**Power:** Selection of 100, 120, 220, or 240 V  $\pm 5\%$  -10%. 50 to 60 Hz and less than 140 VA (less than 140 watts).

**Dimensions:** 90 mm H  $\times$  426 mm W  $\times$  534 mm D (3½"  $\times$  16¾"  $\times$  21").



**Weight:** Net, 12.3 kg (27 lb). Shipping, 14 kg (31 lb).

### Ordering Information:

**8501A** Storage Normalizer

(CRT labeling requires 11864A Labeling Interface Kit or 8505A Option 007)

**Option 907** Front Handle Kit

**Option 908** Rack Mounting Kit

**Option 909** Rack Mounting/Front Handle Kit

**11864A** Labeling Interface Kit

**85010A** Basic Measurements Program Pac

**85010B** Basic Measurements Program Pac



# Test Set Specifications

"SPECIFICATIONS describe the instrument's warranted performance." "SUPPLEMENTAL CHARACTERISTICS are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters." Supplemental characteristics are denoted as typical.

## 8502A 50 $\Omega$ Transmission/Reflection Test Set 8502B 75 $\Omega$ Transmission/Reflection Test Set



Front View



Rear View

**Frequency Range:** 500 kHz to 1.3 GHz.

**Directivity:**  $\geq 40$  dB.

**Frequency Response:**

Transmission:  $\leq \pm 0.8$  dB Magnitude and  $\leq \pm 8^\circ$  Phase<sup>1</sup>.

Reflection:  $\leq \pm 1.5$  dB Magnitude and  $\leq \pm 15^\circ$  Phase<sup>1</sup> from 0.5 to 1300 MHz;  $\leq \pm 10^\circ$  Phase 1 from 2 to 1300 MHz.

**Port Match:**

Test Port:  $\geq 26$  dB Return Loss from 2 to 1300 MHz ( $\geq 24$  dB for 8502B);  $\geq 20$  dB Return Loss from 0.5 to 2 MHz ( $\geq 18$  dB for 8502B).

Test Port Open/Short Ratio:  $\pm 0.75$  dB Magnitude and  $\pm 6^\circ$  Phase from 2 to 1000 MHz;  $\pm 0.9$  dB Magnitude and  $\pm 7.5^\circ$  Phase from 1000 to 1300 MHz;  $\pm 1.25$  dB Magnitude and  $\pm 10^\circ$  Phase from 0.5 to 2 MHz.

Reference and Reflection Port<sup>2</sup>:  $\geq 25$  dB Return Loss from 2 to 1000 MHz;  $\geq 23$  dB Return Loss from 0.5 to 1300 MHz. Input Port<sup>2</sup>:  $\geq 23$  dB Return Loss.

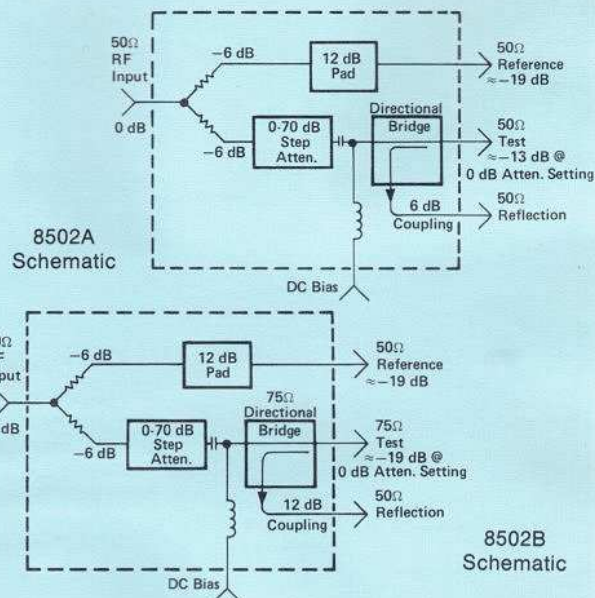
**Nominal Insertion Loss:**

Input to Test Port: 13 dB (8502A), 19 dB (8502B).

Input to Reference Port: 19 dB (8502A), 19 dB (8502B).

<sup>1</sup>Degrees, specified as deviation from linear phase.

<sup>2</sup>Other ports terminated in their characteristic impedance.



Input to Reflection Port: 19 dB (8502A), 31 dB (8502B).

**Maximum Operating Level:**  $\leq +20$  dBm.

**Damage level:**  $> 1$  watt CW.

**RF Attenuator Range:** 0 to 70 dB in 10 dB steps.

**DC Bias Input Range:**  $\pm 30$  V dc,  $\pm 200$  mA, some degradation of RF specifications 0.5 to 100 MHz; 500 mA maximum.

**RF Connectors:** 8502A, 50  $\Omega$  Type N female; 8502B Test Port 75  $\Omega$  Type N female, all other RF connectors 50  $\Omega$  Type N female.

**DC Bias Input Connector:** BNC female.

**Includes:** 8502B includes a 50  $\Omega$  to 75  $\Omega$  minimum loss pad for transmission return.

**Recommended Accessory:** 11851A RF Cable Kit.

**Dimensions:** 615 mm H  $\times$  101 mm W  $\times$  204 mm D ( $2\frac{7}{16}$ "  $\times$   $7\frac{1}{2}$ "  $\times$  8").

**Weight:** Net, 1.7 kg (3.8 lb). Shipping, 2.7 kg (6 lb).

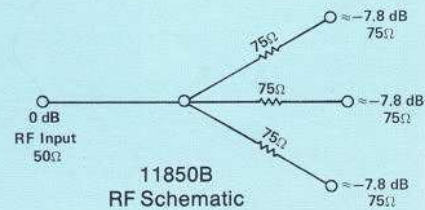
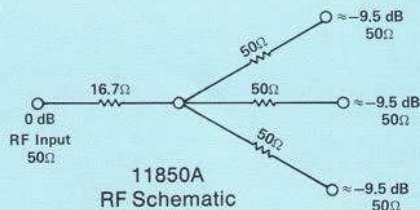
**Ordering Information:**

8502A 50  $\Omega$  Transmission/Reflection Test Set

8502B 75  $\Omega$  Transmission/Reflection Test Set

## 11850A 50 $\Omega$ Power Splitter

## 11850B 75 $\Omega$ Power Splitter



**Frequency Range:** DC to 1.3 GHz.

**Frequency Response Tracking (between any two output ports):**  $\leq 0.1$  dB Magnitude and  $\leq 1.5^\circ$  Phase.

**Equivalent Source Match (Ratio or Leveling):**  $\geq 32$  dB Return Loss.

**Input Port Match:**  $\geq 20$  dB Return Loss.

**Nominal Insertion Loss:** 9.54 dB for 11850A; 7.78 dB for 11850B.

**Frequency Response Absolute:** Input to output  $\leq \pm 0.2$  dB.

**Maximum Operation Level:**  $\leq +20$  dBm.

**Burn-out Level:**  $\geq 1$  watt CW.

**RF Connectors:** 11850A, 50  $\Omega$  Type N female; 11850B Test Ports (3) 75  $\Omega$  Type N female, RF input 50  $\Omega$  Type N female.

**Includes:** 11850B includes three 50  $\Omega$  to 75  $\Omega$  minimum loss pads.

**Dimensions:** 46 mm H  $\times$  67 mm W  $\times$  67 mm D ( $1\frac{7}{8}$ "  $\times$   $2\frac{5}{8}$ "  $\times$   $2\frac{5}{8}$ ").

**Weight:** Net, 1.8 kg (4 lb). Shipping, 3.1 kg (7 lb).

**Ordering Information:**

11850A 50  $\Omega$  Power Splitter

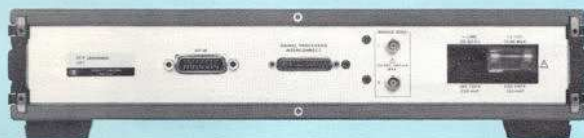
11850B 75  $\Omega$  Power Splitter



**8503A 50  $\Omega$  S-Parameter Test Set**  
**8503B 75  $\Omega$  S-Parameter Test Set**



Front View



Rear View

**Frequency Range:** 500 kHz to 1.3 GHz.

**Impedance:** 8503A, 50  $\Omega$ ; 8503B, 75  $\Omega$ .

**Directivity:**  $\geq 40$  dB.

**Frequency Response:**

Transmission<sup>1</sup> (S<sub>21</sub>, S<sub>12</sub>):  $\pm 1$  dB,  $\pm 12^\circ$  from 0.5 to 1300 MHz.

Reflection<sup>1</sup> (S<sub>11</sub>, S<sub>22</sub>):  $\pm 2$  dB,  $\pm 20^\circ$  from 0.5 to 1300 MHz;  
 $\pm 15^\circ$  from 2 to 1300 MHz.

**Port Match<sup>2</sup>:**

Test Port 1 and 2:  $\geq 26$  dB Return Loss from 2 to 1300 MHz  
( $\geq 24$  dB for 8503B);  $\geq 20$  dB Return Loss from 0.5 to 2 MHz  
( $\geq 18$  dB for 8503B).

Test Port 1 and 2 Open/Short Ratio:  $\leq \pm 0.75$  dB Magnitude and  
 $\pm 6^\circ$  from 2 to 1000 MHz ( $\pm 0.9$  dB and  $\pm 7.5^\circ$  for 8503B);  
 $\leq 0.9$  dB Magnitude and  $\pm 7.5^\circ$  from 1000 MHz to 1300 MHz,  
 $\pm 1.25$  dB Magnitude,  $\pm 10^\circ$  Phase from 0.5 to 2 MHz.

Reference and Return Ports:  $\geq 23$  dB Return Loss from 2 to 1000  
MHz;  $\geq 20$  dB Return Loss from 0.5 to 2 MHz and 1000 to  
1300 MHz.

RF Input Port:  $\geq 20$  dB Return Loss from 0.5 to 1300 MHz.

**Typical Tracking Between Reference and Test Port 1 and 2:**

Transmission<sup>1</sup> (S<sub>21</sub>, S<sub>12</sub>):  $\leq \pm 0.5$  dB Magnitude and  $\leq \pm 4^\circ$   
Phase.

Reflection<sup>1</sup> (S<sub>11</sub>, S<sub>22</sub>):  $\leq \pm 0.75$  dB Magnitude and  $\leq \pm 6^\circ$  Phase.

RF Input to Test Port 1 or 2:  $\leq \pm 1.5$  dB.

**Typical Isolation Between Test Ports:** 100 dB.

**Nominal Insertion Loss:**

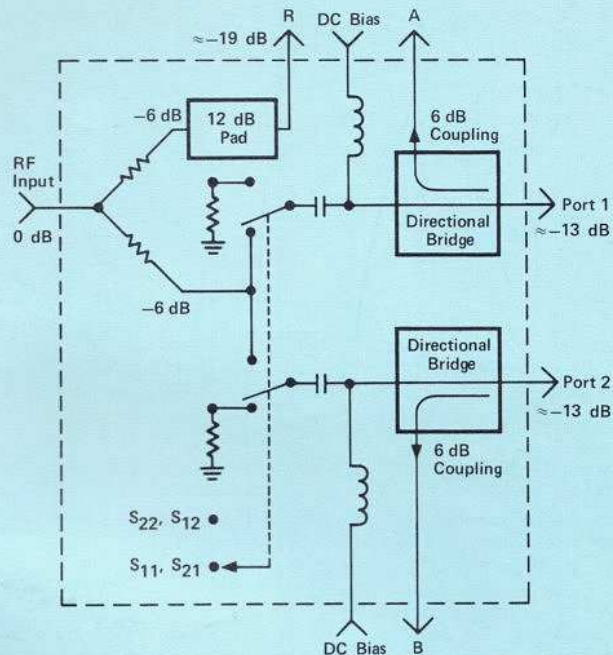
Input to Port 1 & 2: 13 dB (8503A), 19 dB (8503B).

Input to Port R: 19 dB.

Input to Port A or B: 19 dB (8503A), 31 dB (8503B).

<sup>1</sup>  $\pm$  Degrees, specified as deviation from linear phase.

<sup>2</sup> Effective port match for ratio measurement.



8503A RF Schematic

**Maximum Operating Level:** +20 dBm.

**Damage Level:** 1 watt CW.

**Connectors:**

Test Ports: 8503A, 50  $\Omega$  APC-7; 8503B, 75 Type N female.

All Other RF Ports: 50  $\Omega$  Type N female.

DC Bias Inputs: BNC female.

**DC Bias Input Range:**  $\pm 30$  V dc,  $\pm 200$  mA, some degradation  
of RF specifications 0.5 to 100 MHz; 500 mA maximum.

**Includes:** Four 190 mm (7½") cables with Type N male con-  
nectors for connection to 8505A.

**Recommended Accessory:** 11857A 50  $\Omega$  APC-7, 11857B  
Type N 75  $\Omega$  or 11857C GR 900 75  $\Omega$  Test Port Extension  
Cables.

**Programming:** The 8503 A/B provides remote programming  
via the Hewlett-Packard Interface Bus (HP-IB) with Learn Mode.

**Power:** Selection of 100, 120, 220, or 240 V  $\pm 5\%$  -10%, 50 or  
60 Hz. Approximately 10 watts.

**Dimensions:** 90 mm H  $\times$  426 mm W  $\times$  553 mm D (3½"  $\times$   
16¾"  $\times$  21½").

**Weight:** Net, 9.1 kg (20 lb). Shipping, 11.3 kg (25 lb).

**Ordering Information:**

**8503A** 50  $\Omega$  S-Parameter Test Set

**8503B** 75  $\Omega$  S-Parameter Test Set

**Option 907** Front Handle Kit

**Option 908** Rack Flange Kit

**Option 909** Rack Mount Flange/Front Handle Kit

**Option 910** Additional Manual

**11852A 50  $\Omega$  to 75  $\Omega$  Minimum Loss Pad**



**Description:** A low SWR impedance conversion is required  
for accurate transmission measurements of 75  $\Omega$  devices using  
the 8505A Receiver (50  $\Omega$ ). The Minimum Loss Pad provides a  
matched impedance in both directions, 50  $\Omega$  to the 8505A and  
75  $\Omega$  to the device under test.

**Frequency Range:** DC to 1.3 GHz.

**Insertion Loss:** 5.7 dB.

**Return Loss:**  $\geq 30$  dB (50  $\Omega$ ),  $\geq 36$  dB (75  $\Omega$ ).

**Typical Flatness:**  $\pm 0.1$  dB.

**Maximum Input Power:** 250 mW (+24 dBm).

**Connectors:** 50  $\Omega$  Type N female to 75  $\Omega$  Type N male.

**Dimensions:** 14 mm Diameter  $\times$  70 mm Length (9/16"  $\times$  2¾").

**Weight:** Net, 0.1 kg (0.316). Shipping, 0.45 kg (1 lb).



# Accessory Specifications

"SPECIFICATIONS describe the instrument's warranted performance." "SUPPLEMENTAL CHARACTERISTICS are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters." Supplemental characteristics are denoted as typical.

## 11600B/11602B Transistor Fixtures



**Description:** These units allow RF measurements to be made on leaded transistors. Either fixture provides common emitter, base, and collector for bipolars, and common source, gate, and drain for FET's. Other devices also fit the fixtures (tunnel diodes, diodes, etc.).

### Transistor Base Patterns:

**11600B:** Accepts TO-18/TO-72 packages. Will also accept any 3 or 4 lead packages with leads that lie on a 0.1-inch circle and whose diameters are 0.016 to 0.019 inch.

**11602B:** Accepts TO-5/TO-12 packages. Will also accept any 3 or 4 lead package with leads that lie on a 0.2-inch circle and whose diameters are 0.016 to 0.019 inch.

**Calibration References:** Included for calibration of the transistor fixtures are two calibration references; a short circuit termination and a 50  $\Omega$  through-section.

**Lead Lengths:** Up to 1.5 inches long.

**Frequency Ranges:** DC to 2 GHz.

**Impedance:** 50  $\Omega$  nominal.

**Return Loss:** > 26 dB, 100 MHz to 1.0 GHz; > 21 dB from 1 to 2 GHz.

**Connectors:** Hybrid APC-7 precision connectors.  
Option 001: Type N female connectors.

**Recommended Accessory:** The 11858A Transistor Fixture Adapter is recommended for measurements using the 8503A S-Parameter Test Set.

**Maximum Power:** 10 W including RF signals.

**Weight:** Net, 1.1 kg (2.4 lb). Shipping, 1.8 kg (4 lb).

**Dimensions:** 44 mm wide, 152 mm high, 229 mm deep (1 3/4" x 6" x 9").

### Ordering Information:

**11600B** Transistor Fixture

**11602B** Transistor Fixture

**Option 001** (Type N connectors)

## 11608A Transistor Fixture



**Description:** Provides the capability of completely characterizing stripline transistors in either the 0.250 or 0.205 in. dia. package styles. For special package styles, a through-line microstrip and bolt-in grounding structure machinable by customer is available.

**Frequency Range:** DC to 12.4 GHz.

**Impedance:** 50  $\Omega$  nominal.

**Return Loss:** > 26 dB dc to 4 GHz; > 23 dB 4.0 to 8.0 GHz; > 19 dB to 12.4 GHz.

**Microstrip Material:** 0.031 in. polyphenylene oxide (P.P.O.); 0.080 in. wide 50  $\Omega$  stripline.

### Package Styles:

Option 001: Through-line microstrip (P.P.O. plastic) and bolt-in grounding structure machinable by customer for special package styles.

Option 002: 0.250 in. dia.

Option 003: 0.205 in. dia. (HPAC-200)

**Calibration References:** Options 002 and 003 are supplied with two calibration references; a short circuit termination and a 50  $\Omega$  through-section.

**Connectors:** APC-7 Hybrid connectors. Mates with 8503A and 8746B S-Parameter Test Units.

Option 100: Type N female connectors.

**Maximum Power:** 10 W including RF signals.

**Weight:** Net, 0.9 kg (2 lb). Shipping, 1.4 kg (3 lb).

**Dimensions:** 25 mm H x 143 mm W x 89 mm D (1" x 5 5/8" x 3 1/2").

### Ordering Information:

**11608A** Transistor Fixture (must be ordered with

Option 001, 002, or 003)

**Option 001**

**Option 002**

**Option 003**

**Option 100** (Type N female connectors)

## 1121A AC Probe

**Description:** For making signal measurements without disturbing circuitry and for measuring voltage transfer function in impedance systems radically different from 50  $\Omega$ . Furnished with 10:1 and 100:1 divider and BNC adapter.

**Bandwidth (3 dB):** 1 kHz to > 500 MHz.

**Gain:** 0 dB  $\pm$  1 dB.

**Frequency Response:** 1 kHz to 100 MHz,  $\pm$ 0.5 dB,  $\pm$ 2°.

**Input Impedance:** 100 k $\Omega$ , shunt capacitance 3 pF at 100 MHz.  
With 10:1 or 100:1 divider, 1 M $\Omega$  shunt capacitance 1 pF at 100 MHz.

**Output Impedance:** 50  $\Omega$  nominal.

**Maximum Input:** 300 mV rms,  $\pm$ 100 V dc.

With 10:1 divider, 3 V rms,  $\pm$ 350 V dc.

With 100:1 divider, 30 V rms,  $\pm$ 350 V dc.

**Power:** Supplied by 8505A through PROBE PWR jacks. Warning: The output of the 1121A is direct coupled and has an output voltage of approximately -2 to -4 V. The output must not be dc coupled or the probe may be permanently damaged. If using the 1121A with instruments other than the 8505A, or if an attenuator pad is to be used at the probe output, be sure a blocking capacitor is provided. Model 10240B or equivalent can be used.

**Weight:** Net, 0.7 kg (1.5 lb). Shipping, 1.2 kg (2.5 lb).



11858A



1121A

## 11858A Transistor Fixture Adapter

**Description:** Provides a rigid RF cable interconnection (horizontal to vertical test port orientation) between the 8503A S-Parameter Test Set and the 11600B/11602B Transistor Fixtures.

**Typical Return Loss:** > 26 dB.

**Connectors:** APC-7.

**Dimensions:** 99 mm H x 178 mm W x 133 mm D (3.9" x 7" x 5.3").

**Weight:** Net, 0.7 kg (1.5 lb). Shipping, 0.9 kg (2.1 lb).

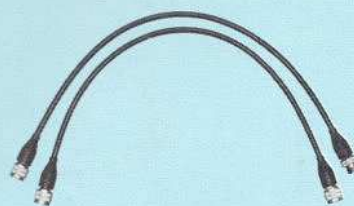




11851A



11857A



11857B



11857C

#### 11851A RF Cable Kit

**Description:** Provides the necessary RF interconnections and RF shielding required for 8505A Network Analyzer measurements when using the 8502A, 8502B, Transmission Reflection Test Sets or the 11850A, 11850B Power Splitters.

**Kit Includes:** Three 610 mm (24") 50 Ω cables, phase matched to 4° at 1.3 GHz and one cable 860 mm (34").

**Connectors:** 50 Ω Type N male.

**Weight:** Net, 0.9 kg (2 lb). Shipping, 2.3 kg (5 lb).

#### 11857A APC-7 Test Port Extension Cables

**Description:** Two precision 50 Ω cables extend the 8503A test ports for convenient measurements of devices having any two-port geometry.

**Kit Includes:** Two 610 mm (24") 50 Ω cables, phase matched to 2° at 1.3 GHz.

**Connectors:** APC-7.

**Weight:** Net, 0.9 kg (2 lb). Shipping, 2.3 kg (5 lb).

#### 11857B 75 Ω Type N Test Port Extension Cables

**Description:** Two precision 75 Ω cables extend the 8503B test ports for convenient measurement of devices having any two-port geometry.

**Kit Includes:** Two 610 mm (24") 75 Ω cables, phase matched to 2° at 1.3 GHz.

**Connectors:** One cable has 75 Ω Type N male connectors on both ends; the other has one Type N male and one Type N female connector.

**Weight:** Net, 0.9 kg (2 lb). Shipping, 2.3 kg (5 lb).

#### 11857C 75 Ω GR-900 Test Port Extension Cables

**Description:** Two precision 75 Ω cables extend the 8503B test ports for convenient measurement of devices having any two-port geometry.

**Kit Includes:** Two 610 mm (24") 75 Ω cables, phase matched to 2° at 1.3 GHz.

**Connectors:** Both cables have a 75 Ω Type N male connector on one end and a 75 Ω GR-900 connector on the other end.

**Weight:** Net, 0.9 kg (2 lb). Shipping, 2.3 kg (5 lb).

## Application and Measurement Pacs

#### 85030A (8507A/9830B) Applications Pac

**Description:** Provides three cassette programs. The Accuracy Enhancement Program (AIM-30) improves measurement accuracy by removing mismatch, directivity, and frequency tracking errors for both one- and two-port devices. The Verification Program operationally checks computer/network analyzer interfaces. The Basic Measurements Program makes the features of Learn Mode and data printing, plotting (with the 9862A Plotter), and normalization available to the non-programmer.

**Includes:** Cassettes and Operating/Programmers Manual.

**Weight:** Net, 1.1 kg (2.5 lb). Shipping, 3.6 kg (8 lb).

#### 85030B (8507B/9825A) Applications Pac

**Description:** Provides cartridge containing three programs. The Accuracy Enhancement Program (AIM-30) improves measurement accuracy by removing mismatch, directivity, and frequency tracking errors for both one- and two-port devices. The Verification Program operationally checks computer/network analyzer interfaces. The Basic Measurements Program makes the features of Learn Mode and data printing, plotting (with the 9872A or 9862A Plotters), and normalization available to the non-programmer.

**Includes:** Cartridges and Operating/Programmers Manual.

**Weight:** Net, 1.1 kg (2.5 lb). Shipping, 3.6 kg (8 lb).

#### 85010A (8505A/8501A/9830B) Basic Measurements Pac

**Description:** Provides 8501A Basic Measurements Program to be used with 8507A Automatic Network Analyzer Systems which incorporate the 8501A Storage Normalizer. This program utilizes the fast normalization, averaging, and transfer of data provided by the 8501A to make fast automatic RF network measurements covering the 0.5 MHz to 1.3 GHz frequency range.

**Includes:** Cassette and Operating/Programmers Manual.

**Weight:** Net, 0.9 kg (2 lb). Shipping, 1.4 kg (3 lb).

#### 85010B (8505A/8501A/9825A) Basic Measurements Pac

**Description:** Provides 8501A Basic Measurements Program to be used with 8507B Automatic Network Analyzer Systems which incorporate the 8501A Storage Normalizer. This program utilizes the fast normalization, averaging, and transfer of data provided by the 8501A to make fast automatic RF network measurements covering the 0.5 MHz to 1.3 GHz frequency range.

**Includes:** Cartridge and Operating/Programmers Manual.

**Weight:** Net, 0.9 kg (2 lb). Shipping, 1.4 kg (3 lb).



# Accessory Kit Specifications



## 11853A 50 Ω Type N Accessory Kit

**Description:** The 11853A furnishes the RF components generally required when using the 8502A, 11850A, and the 8503A (8503A requires 85032A also) when measuring devices having 50 Ω Type N connectors. The characteristics of the components in this kit insure high quality (typically > 40 dB return loss at 1.3 GHz) RF measurements for those devices having 50 Ω Type N connectors.

### Kit Includes:

Qty.	Description
1	Type N female short (HP 11511A)
1	Type N male short (HP 11512A)
2	Type N male (HP 1250-1475) to Type N male adapter
2	Type N female (HP 1250-1472) to Type N female adapter
1	Storage case

**Dimensions:** 64 mm H × 190 mm W × 140 mm D (2½" × 7½" × 5½").

**Weight:** Net, 0.7 kg (1.5 lb). Shipping, 1.4 kg (3 lb).



## 11855A 75 Ω Type N Accessory Kit

**Description:** The 11855A furnishes the RF components generally required when using the 8502B, 11850B, and the 8503B when measuring devices having 75 Ω Type N connectors. The characteristics of the components in this kit insure high quality (typically > 34 dB return loss at 1.3 GHz for a pair) RF measurements for those devices having 75 Ω Type N connectors.

### Kit Includes:

Qty.	Description
1	75 Ω Type N female short (HP 1250-1531)
1	75 Ω Type N male short (HP 1250-1530)
2	75 Ω Type N male (HP 1250-1528) to Type N male adapter
2	75 Ω Type N female (HP 1250-1529) to Type N female adapter
1	75 Ω Type N male termination (HP 1250-1532)
1	Storage case

**Dimensions:** 64 mm H × 190 mm W × 140 mm D (2½" × 7½" × 5½").

**Weight:** Net, 0.7 kg (1.5 lb). Shipping, 1.4 kg (3 lb).



## 11854A 50 Ω BNC Accessory Kit

**Description:** The 11854A furnishes the RF components generally required when using the 8502A, 11850A, and the 8503A (8503A requires 85032A also) when measuring devices having 50 Ω BNC connectors. The characteristics of the components in this kit insure high quality (typically > 36 dB return loss at 1.3 GHz for a pair) RF measurements for those devices having 50 Ω BNC connectors.

### Kit Includes:

Qty.	Description
2	Type N male to BNC female adapter (HP 1250-1476)
2	Type N male to BNC male adapter (HP 1250-1473)
2	Type N female to BNC male adapter (HP 1250-1477)
2	Type N female to BNC female adapter (HP 1250-1474)
1	BNC male short (HP 1250-0929)
1	Storage case

**Dimensions:** 64 mm H × 190 mm W × 140 mm D (2½" × 7½" × 5½").

**Weight:** Net, 0.7 kg (1.5 lb). Shipping, 1.4 kg (3 lb).



## 11856A 75 Ω BNC Accessory Kit

**Description:** The 11856A furnishes the RF components generally required when using the 8502B, 11850B, and the 8503B when measuring devices having 75 Ω BNC connectors. The characteristics of the components in this kit insure high quality (typically > 34 dB return loss at 1.3 GHz for a pair) RF measurements for those devices having 75 Ω BNC connectors.

### Kit Includes:

Qty.	Description
2	75 Ω Type N male to BNC female adapter (HP 1250-1535)
2	75 Ω Type N male to BNC male adapter (HP 1250-1533)
2	75 Ω Type N female to BNC male adapter (HP 1250-1534)
2	75 Ω Type N female to BNC female adapter (HP 1250-1536)
1	BNC male short (HP 1250-0929)
1	BNC male termination (HP 11652-60010) typically < 1.032 SWR at 2 GHz
1	Storage case

**Dimensions:** 64 mm H × 190 mm W × 140 mm D (2½" × 7½" × 5½").

**Weight:** Net, 0.7 kg (1.5 lb). Shipping, 1.4 kg (3 lb).



# Calibration Kit Specifications



## 85031A Verification and APC-7 Calibration Kit

**Description:** This kit is furnished with the 8507 Automatic Network Analyzer and is used for verification of measurement system performance.

**Kit Includes:**

Qty.	Description
1	APC-7 50 $\Omega$ termination (HP 909A, Option H68)
	<1.005 SWR at 2 GHz
1	APC-7 short (HP 11565A)
1	APC-7 3 dB pad (HP 8492A, Option 003)
1	APC-7 50 dB pad (HP 8492A, Option 050)
1	Storage case

**Dimensions:** 64 mm H  $\times$  190 mm W  $\times$  140 mm D (2½"  $\times$  7½"  $\times$  5½").

**Weight:** Net, 0.7 kg (1.5 lb). Shipping, 1.4 kg (3 lb).



## 85033A SMA Calibration Kit

**Description:** This kit is recommended for use with the 8503A S-Parameter Test Set or 8507 Automatic Network Analyzer for measurement of devices having SMA RF connectors.

**Kit Includes:**

Qty.	Description
2	APC-7 to SMA female adapter (HP 1250-1012)
2	APC-7 to SMA male adapter (HP 1250-1007)
1	50 $\Omega$ SMA female termination (HP 0960-0050)
1	50 $\Omega$ SMA male termination (HP 0960-0053)
1	SMA female short (HP 0960-0054)
1	SMA male short (HP 0960-0055)
1	Storage case

**Dimensions:** 64 mm H  $\times$  190 mm W  $\times$  140 mm D (2½"  $\times$  7½"  $\times$  5½").

**Weight:** Net, 0.7 kg (1.5 lb). Shipping, 0.9 kg (2 lb).



## 85032A 50 $\Omega$ Type N Calibration Kit

**Description:** This kit is recommended for use with the 8503A S-Parameter Test Set or 8507 Automatic Network Analyzer for measurement of devices having 50  $\Omega$  Type N RF connectors.

**Kit Includes:**

Qty.	Description
2	APC-7 to Type N female adapter (HP 11524A)
2	APC-7 to Type N male adapter (HP 1152A)
1	50 $\Omega$ Type N female termination (HP 909A, Option H70) <1.005 SWR at 2 GHz
1	50 $\Omega$ Type N male termination (HP 909A, Option H69) <1.005 SWR at 2 GHz
1	Type N female short (HP 11511A)
1	Type N male short (HP 11512A)
1	Storage case

**Dimensions:** 88 mm H  $\times$  254 mm W  $\times$  266 mm D (3½"  $\times$  10"  $\times$  10½").

**Weight:** Net, 1.4 kg (3 lb). Shipping, 2.3 kg (5 lb).



## 85036A 75 $\Omega$ Type N Calibration Kit

**Description:** This kit is furnished with the E75 8507 Automatic Network Analyzer and is used to make error corrected measurements using the AIM software in 75  $\Omega$  Type N connector systems.

**Kit Includes:**

Qty.	Description
1	75 $\Omega$ Type N male termination (HP 1250-1540)
	<1.005 SWR at 2 GHz
1	75 $\Omega$ Type N female termination (HP 1250-1541)
	<1.005 SWR at 2 GHz
1	75 $\Omega$ Type N male short (HP 1250-1530)
1	75 $\Omega$ Type N female short (HP 1250-1531)
1	75 $\Omega$ Type N male barrel (HP 1250-1528)
1	75 $\Omega$ Type N female barrel (HP 1250-1529)
1	Storage case

**Dimensions:** 64 mm H  $\times$  190 mm W  $\times$  140 mm D (2½"  $\times$  7½"  $\times$  5½").

**Weight:** Net, 0.7 kg (1.5 lb). Shipping, 1.0 kg (2 lb).



# Ordering Information

## 8505A NETWORK ANALYZER

### 8505A RF Network Analyzer

- Option 005** Phase-lock
- Option 007** Labeling Interface for 8501A
- Option 907** Front Handles Kit
- Option 908** Rack Mounting Kit
- Option 909** Rack Mounting/Front Handles Kit
- Option 910** Extra Manual

### TYPICAL SYSTEM

<b>8505A</b>	RF Network Analyzer
<b>Opt. 007</b>	8501A Labeling Interface
<b>8501A</b>	Storage Normalizer
<b>8502A</b>	50 $\Omega$ Transmission/Reflection Test Set
<b>11851A</b>	RF Cable Kit
<b>11854A</b>	BNC Accessory Kit

## 8507B AUTOMATIC NETWORK ANALYZER

### 8507B Automatic Network Analyzer

#### System components include:

- 8505A** Network Analyzer with Option 907, Handles
- 8503A** S-Parameter Test Set with Option 907, Handles
- 11857A** Test Port Extension Cables
- 85030B** Applications PAC for 8507B/9825A
- 85031A** Verification and APC-7 Calibration Kit
- 9825S** Desktop Computer (includes 23K Bytes Memory, 98210A, and 98216A ROM's)
- 9866B** Printer with Option 025, 9825A Interface
- 98034A** HP-IB Interface card
- 98226A** Calculator Cradle
- Systems Table

Factory assembly and checkout prior to shipment

**Option 002** Delete Systems Table

**Option 003** Delete 9825S Desktop Computer  
Delete 9825S; 9866B; 98034A;  
and the 98226A Computer Cradle

**Option 005** Phase-lock  
Adds Option 005 to the 8505A. The  
documentation includes sample programs and  
recommended changes to the Basic Measurements  
Program.

**Option 006** Storage Normalizer  
Adds an 8501A Storage Normalizer with Option  
907, Handles; 8505A Option 007, Labeling  
Interface; and 85010B Basic Measurements Pac.  
(8505A/8501A/9825A)

## 8501A STORAGE NORMALIZER

### 8501A Storage Normalizer

(CRT labeling requires 11864A Labeling Interface Kit or  
8505A Option 007)

- Option 907** Front Handle Kit
- Option 908** Rack Mounting Kit
- Option 909** Rack Mounting/Front Handle Kit
- 11864A** Labeling Interface Kit



## TEST SETS

- 8502A** 50  $\Omega$  Transmission/Reflection Test Set  
**Option 910** Extra Manual
- 8502B** 75  $\Omega$  Transmission/Reflection Test Set  
**Option 910** Extra Manual
- 8503A** 50  $\Omega$  S-Parameter Test Set  
**Option 907** Front Handle Kit  
**Option 908** Rack Mounting Kit  
**Option 909** Rack Mounting/Front Handle Kit  
**Option 910** Extra Manual
- 8503B** 75  $\Omega$  S-Parameter Test Set  
**Option 907** Front Handle Kit  
**Option 908** Rack Mounting Kit  
**Option 909** Rack Mounting/Front Handle Kit  
**Option 910** Extra Manual

## RETROFIT KITS\*

- 11860A** HP-IB Interface Kit for 8505A  
Field installable version of 8505A Option 001 for the 8505A with serial prefix number 1833 and below.
- 11861A** HP-IB Interface Kit for 8503A/B  
Field installable version of 8503A/B Option 001 for the 8503 with serial prefix number 1746 and below.
- 08505-60201** Retrofit Kit  
A field installable version of the Option 005 for the 8505A with serial prefix numbers 1653 and below.
- 08505-60200** Retrofit Kit  
A field installable version of the Option 005 for the 8505A with serial prefix numbers 1710 through 1806.
- 08505-60226** Retrofit Kit  
A field installable version of the Option 005 for the 8505A with serial prefix numbers 1816 and above.

## CALIBRATION KITS

- 85031A** Verification and APC-7 Calibration Kit
- 85032A** 50  $\Omega$  Type N Calibration Kit
- 85033A** 50  $\Omega$  SMA Calibration Kit
- 85036A** 75  $\Omega$  Type N Calibration Kit

## COAXIAL ACCESSORIES

- 11850A** 50  $\Omega$  Power Splitter
- 11850B** 75  $\Omega$  Power Splitter
- 11851A** RF Cable Kit
- 11852A** 50–75  $\Omega$  Minimum Loss Pad
- 11853A** 50  $\Omega$  Type N Accessory Kit
- 11854A** 50  $\Omega$  BNC Accessory Kit
- 11855A** 75  $\Omega$  Type N Accessory Kit
- 11856A** 75  $\Omega$  BNC Accessory Kit
- 11857A** 50  $\Omega$  Test Port Extension Cables
- 11857B** 75  $\Omega$  Type N Test Port Extension Cables
- 11857C** 75  $\Omega$  GR-900 Test Port Extension Cables
- 11858A** Transistor Fixture Adapter

## CONTROLLER PROGRAMS

- 85030A** Applications Pac for 8507A/9830B  
Complete compatibility requires: 8505A; 8503A; 9830B; 9866A; 59405A; and an 8503XA series Calibration Kit.
- 85030B** Applications Pac for 8507B/9825A  
Complete compatibility requires: 8505A; 8503A; 9825A, Option 002; 9866B, Option 025; 98210A; 98216A; 98034A; and an 8503XA series Calibration Kit.
- 85010A** Basic Measurements Pac for 8505A/8501A/9830B  
Complete compatibility requires: 8505A; 8501A; 8503A; 9830B; 9866A; 59405A; and an 8503XA series Calibration Kit.
- 85010B** Basic Measurements Pac for 8505A/8501A/9825A  
Complete compatibility requires: 8505A; 8501A; 8503A; 9825A, Option 002; 9866B, Option 025; 98210A; 98216A; 98034A; and an 8503XA series Calibration Kit.

\* For further information regarding installation by HP personnel, contact your HP field office.





For more information, call your local HP sales office or East (301) 258-2000 • Midwest (312) 255-9600 • South (404) 955-1500 • West (213) 877-1282. Or write, Hewlett-Packard, 1501 Page Mill Rd., Palo Alto, California 94304  
In Europe, Hewlett-Packard S.A., 7, rue du Bois-du-lan, P.O. Box, CH-1217 Meyrin 2-Geneva, Switzerland. In Japan, Yokogawa-Hewlett-Packard Ltd., 29-21, Takaide-Higashi 3-chome, Suganami-ku, Tokyo 168

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